0072351

Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

MAR 02 2007

07-AMCP-0108

Ms. Jane A. Hedges, Program Manager
Nuclear Waste Program
State of Washington
Department of Ecology
3100 Port of Benton Boulevard
Richland, Washington 99354

RECEIVED
MAR 08 2007
EDMC

Dear Ms Hedges:

SAMPLING AND ANALYSIS PLAN (SAP) FOR SUPPLEMENTAL REMEDIAL INVESTIGATION ACTIVITIES AT MODEL GROUP 5, LARGE AREA PONDS, WASTE SITES, DOE/RL-2006-57, DRAFT A

The purpose of this letter is to transmit the enclosed SAP for Supplemental Remedial Investigation Activities at Model Group 5, Large Area Ponds, Waste Sites, DOE/RL-2006-57, Draft A, to the State of Washington, Department of Ecology (Ecology) for review and approval by March 30, 2007.

This SAP addresses supplemental remedial investigation of Central Plateau Ponds waste sites, consistent with the Tentative Agreement on Negotiations to Modify Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) Commitments for Completing the Remedial Investigation/Feasibility Study (RI/FS) and Resource Conservation and Recovery Act Facility Investigation/Corrective Measures Study Processes for All 200 Area Non-Tank Farms Operable Units dated October 4, 2006. The waste sites included in this SAP reflect Tri-Party Agreement, Appendix C proposed changes that move pond-related waste sites into the 200-CW-1 Operable Unit, for which Ecology is the lead regulatory agency.

This SAP is being transmitted in advance of the RI/FS Work Plan for Tri-Party Agreement Milestone M-15 Supplemental Remedial Investigation that is due to the U.S. Environmental Protection Agency (EPA) and Ecology on March 31, 2007, under proposed Tri-Party Agreement Milestone M-13-50. This SAP completes a portion of the overall work plan scope and will be incorporated into the work plan by reference. Advanced approval of this SAP will allow initiation of field work in Fiscal Year 2007 to provide continuity of field crews concurrent with work plan preparation, review, comment, and approval.

This SAP was developed as part of the collaborative Model Group 5, Large Area Ponds, Data Quality Objectives (DQO) process with the U.S. Department of Energy, Richland Operations Office, EPA and Ecology. One issue remains outstanding from the DQO pertaining to Ecology requests for additional sampling at 216-S-16, 216-S-17, and 216-T-4B Ponds to meet a

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95 percent upper confidence limit. In discussions during the separate RI/FS Work Plan DQO, Ecology and EPA indicated agreement with submittal of this SAP concurrent with continued discussions on the open issue.

If there are any questions, please contact me, or your staff may contact, Briant Charboneau, of my staff, on (509) 373-6137.

Sincerely,

Matthew S. McCormick, Assistant Manager
for the Central Plateau

AMCP:BLF

Enclosure

cc w/encl:
B. A. Austin, FHI
T. B. Bergman, FHI
G. Bohnee, NPT
N. Ceto, EPA
S. Harris, CTUIR
R. Jim, YN
S. L. Leckband, HAB
S. N. Luke, FHI
J. L. Nuzum, FHI
K. Niles, ODOE
R. E. Piippo, FHI
M. E. Todd-Robertson, FHI
J. G. Vance, FFS
Administrative Record OU 200-CW-1, 200-CW-2, 200-CW-4, 200-CW-5, 200-CS-1
Environmental Portal TPA M-15, M-13-50

DOE/RL-2006-57
DRAFT A

Sampling and Analysis Plan for Supplemental Remedial Investigation Activities at Model Group 5, Large-Area Ponds, Waste Sites

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

United States
Department of Energy
P.O. Box 550
Richland, Washington 99352

DOE/RL-2006-57
DRAFT A

Sampling and Analysis Plan for Supplemental Remedial Investigation Activities at Model Group 5, Large-Area Ponds, Waste Sites

Date Published
February 2007

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

United States
Department of Energy
P.O. Box 550
Richland, Washington 99352

J. D. Aardal 2/5/2007
Release Approval Date

EXECUTIVE SUMMARY

This sampling and analysis plan (SAP) addresses supplemental data collection at the waste sites of Model Group 5, Large-Area Ponds. This group comprises the thirteen 200 Areas non-tank farm waste sites originally grouped for remedial investigation in five separate process-based operable units (OU), including 200-CS-1, 200-CW-1, 200-CW-2, 200-CW-4, and 200-CW-5. Grouping of these waste sites into their respective process-based OUs was based on similarity of site configuration, waste-generating processes, and anticipated nature and extent of contamination (contaminant distribution model) as described in DOE/RL-98-28, *200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program*. These five OUs were further consolidated for remedial investigation into three separate *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) remedial investigation/feasibility study processes, each having a remedial investigation/feasibility study work plan, feasibility study, and proposed plan, with the anticipated outcome being a record of decision that generally adopts the remedial alternative recommended in the proposed plan.

To streamline characterization of the OUs having multiple, similar waste sites, an 'analogous-site' approach was initiated. This approach required characterization of certain waste sites considered to be 'representative' of other OU waste sites because they represent typical or bounding contamination conditions for their respective analogous waste sites. Remedial investigation data generally were not collected from the analogous waste sites. During the remedial investigation/feasibility study processes for these OUs, decision makers expressed concerns regarding uncertainties associated with selecting a preferred remedial alternative for the uncharacterized analogous waste sites and for some characterized representative waste sites. Consequently, an improved path forward, termed the 'Model Groups,' was conceived to ensure that sufficient data exist for the analogous waste sites to support remedial decision making. As an initial step in this process, the Tri-Parties (Washington State Department of Ecology, U.S. Environmental Protection Agency, and the U.S. Department of Energy) grouped waste sites into seven 'bins' based on an updated understanding gained from the remedial investigations performed under the approved work plans. Each bin was assigned a separate 'Model Group,' numbered one through seven, as follows:

- Model Group 1, Shallow, Straightforward-Decision Sites
- Model Group 2, Deep-Contamination Sites
- Model Group 3, Large Sites with Near-Surface Plutonium Contamination
- Model Group 4, Small and Medium Sites with Plutonium Contamination
- Model Group 5, Large-Area Ponds
- Model Group 6, Sites with Shallow and Deep Contamination
- Model Group 7, Unique Conceptual-Model Sites.

The first model group selected for evaluation was Model Group 5, Large-Area Ponds, which are the subject of this SAP. A data quality objectives process (Section 1.7) was initiated that identified the large-area pond waste sites needing further data to reach a remedial decision. The pond waste sites identified during the data quality objectives process as requiring further investigation include the 216-A-25 Pond, 216-B-3 Pond, 216-S-16 Pond, 216-S-17 Pond (and associated UPR-200-W-124), 216-T-4B Pond, 216-U-10 Pond, and the 216-U-11 Ditch. Data collection will focus on obtaining additional data from vadose-zone soils beneath the ponds through observational methods, primarily gamma logging of direct-push probes, as well as focused soil sampling in elevated contamination concentration areas. This SAP defines the approach for collection of supplemental data at these sites that will provide new information having the potential to impact final remedy selection, such as reduced institutional controls, specific barrier requirements, opportunities for partial excavation, and sites located outside of the industrial-exclusive zone where remediation could affect future land-use options. The characterization planned through this data quality objectives process and provided for in this SAP could, in some instances, satisfy confirmatory sampling requirements ahead of the records of decision.

CONTENTS

APPENDIX

FIGURES

TABLES

TERMS

AA	alternative action
AEA	alpha energy analysis
aG	amber glass
ALARA	as low as reasonably achievable
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
COPC	contaminant of potential concern
CVAA	cold vapor atomic absorption
DOE	U.S. Department of Energy
DQO	data quality objective
DR	decision rule
DS	decision statement
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FS	feasibility study
FSP	field sampling plan
G	glass
GC/MS	gas chromatography/mass spectrometry
GEA	gamma energy analysis
GPC	gas proportional counter
HEIS	*Hanford Environmental Information System* database
IC	ion chromatography
ICP	inductively coupled plasma
ICP/MS	inductively coupled plasma/mass spectrometry
IDW	investigation-derived waste
Implementation Plan	*200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program* (DOE/RL-98-28)
MESC	maintain existing soil cover
N/A, NA	not applicable
NR	not required
OU	operable unit
P	plastic
PHMC	Project Hanford Management Contractor or Contract
PP	proposed plan
PS	problem statement
PSQ	principal study question
PUREX	Plutonium/Uranium Extraction (Plant)
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control

RCRA	*Resource Conservation and Recovery Act of 1976*
REDOX	Reduction/Oxidation (Plant)
RESRAD	RESidual RADioactivity dose model (ANL, 2002)
RESRAD-BIOTA	RESidual RADioactivity for biota dose model (ANL, 2006)
RI	remedial investigation
RL	DOE Richland Operations Office
ROD	record of decision
SAP	sampling and analysis plan
STOMP	Subsurface Transport Over Multiple Phases code (see PNNL-12028)
SVOA	semivolatile organic analyte
TBC	to be considered
TBD	to be determined
Tri-Parties	DOE, EPA, and Ecology
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989)
UPR	unplanned release
VOA	volatile organic analyte
WAC	*Washington Administrative Code*
WISA	*Waste Information Data System* database
Work plan	remedial investigation/feasibility study work plan

METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
If you know	*Multiply by*	*To get*	*If you know*	*Multiply by*	*To get*
Length			**Length**		
inches	25.40	millimeters	millimeters	0.0394	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles (statute)	1.609	kilometers	kilometers	0.621	miles (statute)
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.0929	sq. meters	sq. meters	10.764	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.591	sq. kilometers	sq. kilometers	0.386	sq. miles
acres	0.405	hectares	hectares	2.471	acres
Mass (weight)			**Mass (weight)**		
ounces (avoir)	28.349	grams	grams	0.0353	ounces (avoir)
pounds	0.454	kilograms	kilograms	2.205	pounds (avoir)
tons (short)	0.907	ton (metric)	ton (metric)	1.102	tons (short)
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.034	ounces (U.S., liquid)
tablespoons	15	milliliters	liters	2.113	pints
ounces (U.S., liquid)	29.573	milliliters	liters	1.057	quarts (U.S., liquid)
cups	0.24	liters	liters	0.264	gallons (U.S., liquid)
pints	0.473	liters	cubic meters	35.315	cubic feet
quarts (U.S., liquid)	0.946	liters	cubic meters	1.308	cubic yards
gallons (U.S., liquid)	3.785	liters			
cubic feet	0.0283	cubic meters			
cubic yards	0.764	cubic meters			
Temperature			**Temperature**		
Fahrenheit	(°F-32)*5/9	Centigrade	Centigrade	(°C*9/5)+32	Fahrenheit
Radioactivity			**Radioactivity**		
picocurie	37	millibecquerel	millibecquerel	0.027	picocurie

1.0 INTRODUCTION

This sampling and analysis plan (SAP) supports supplemental remedial investigation (RI) activities that the U.S. Department of Energy (DOE), Richland Operations Office (RL), U.S. Environmental Protection Agency (EPA), and the Washington State Department of Ecology (Ecology) have determined are necessary to make or augment remedial decisions for waste sites on the Central Plateau of the Hanford Site. This SAP represents a site-specific data-collection strategy and plan for the Model Group 5, Large-Area Ponds, waste group sites that were determined during the data quality objective (DQO) process (Appendix A) to require more data to make remedial decisions. This SAP also includes a quality assurance project plan (QAPjP) to support the sampling activities.

1.1 BACKGROUND

In 1999, DOE, EPA, and Ecology, the Tri-Parties to the *Hanford Federal Facility Agreement and Consent Order* (Ecology et. al., 1989) (Tri-Party Agreement), approved DOE/RL-98-28, *200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program*, (Implementation Plan). This plan detailed the strategy for a streamlined approach to collecting remedial investigation (RI) data, which relied on a process-based grouping of waste sites into 23 operable units (OU). The plan identified the use of remedial investigation /feasibility study (RI/FS) work plans that would focus RI activities on a defined set of representative waste sites. The representative waste sites were preliminarily identified in DOE/RL-98-28 and were reviewed as part of the individual OU DQOs, to ensure that they adequately represented the OU as either typical or bounding of the other waste sites in the OU. Under the Implementation Plan, the decisions were to be made on the representative waste sites, thereby streamlining and reducing costs for the RIs. Data on analogous waste sites would be collected following issuance of the record of decision (ROD) and would be focused on defining the extent of contamination, obtaining design data, and confirming that the analogous waste site conceptual model was appropriately represented by the representative waste site.

Between 1999 and 2001, RI/FS work plans were developed and approved for the following OUs:

- 200-CW-1 Gable Mountain Pond/B Pond and Ditches Cooling Water Waste Group Operable Unit (DOE/RL-99-07, *200-CW-1 Operable Unit RI/FS Work Plan and 216-B-3 RCRA TSD Unit Sampling Plan*)
- 200-CS-1 Chemical Sewer Waste Group Operable Unit (DOE/RL-99-44, *200-CS-1 Operable Unit RI/FS Work Plan and RCRA TSD Unit Sampling Plan*)
- 200-TW-1 Scavenged Waste Group/200-TW-2 Tank Waste Group/200-PW-5 Waste Group Operable Units (DOE/RL-2000-38, *200-TW-1 Scavenged Waste Group Operable Unit and 200-TW-2 Tank Waste Group Operable Unit RI/FS Work Plan*).

In 2001 and 2002, the Tri-Parties negotiated a change to the Tri-Party Agreement that would consolidate the RI/FS work plans for some of the OUs. To date, RI/FS work plans have been approved for the following OUs or OU groups:

- 200-CW-5 U Pond/Z-Ditches Cooling Water Waste Group Operable Unit (DOE/RL-99-66, *Steam Condensate/Cooling Water Waste Group Operable Units RI/FS Work Plan; Includes: 200-CW-5, 200-CW-2, 200-CW-4, and 200-SC-1 Operable Units*, Rev. 1)

- 200-PW-2 Uranium-Rich Process Waste Group/200-PW-4 General Process Waste Group Operable Units (DOE/RL-2000-60, *Uranium-Rich/General Process Condensate and Process Waste Group Operable Units RI/FS Work Plan and RCRA TSD Unit Sampling Plan; Includes 200-PW-2 and 200-PW-4 Operable Units*, Rev. 1, Reissue)

- 200-LW-1 200 Area Chemical Laboratory Waste Group/200-LW-2 300 Area Chemical Laboratory Waste Group Operable Units (DOE/RL-2001-66, *Chemical Laboratory Waste Group Operable Units RI/FS Work Plan, Includes: 200-LW-1 and 200-LW-2 Operable Units*, Rev. 1)

- 200-MW-1 Miscellaneous Waste Group Operable Unit (DOE/RL-2001-65, *Chemical Laboratory Waste Group Operable Units RI/FS Work Plan, Includes: 200-LW-1 and 200-LW-2 Operable Units*, Rev. 1)

- 200-PW-1 Plutonium/Organic Rich Process Waste Group/200-PW-3 Organic Rich Process Waste Group/200-PW-6 Plutonium Rich Process Waste Group Operable Units (DOE/RL-2001-01, *Plutonium/Organic-Rich Process Condensate/Process Waste Group Operable Unit RI/FS Work Plan, Includes: 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units*, Rev. 0, Reissue)

1.2 WASTE SITE BINNING

The RIs for the Model Group 5, Large-Area Ponds waste sites previously were addressed in the 200-CS-1 Chemical Sewer, 200-CW-1 Gable Mountain Pond/B Pond and Ditches, and 200-CW-5 U Pond/Z-Ditches waste group RI/FS work plans (DOE/RL-99-44, DOE/RL-99-07, and DOE/RL-99-66, respectively). The associated RI data were collected, reported, and evaluated through RI reports and FSs. Proposed plans (PP) were developed to support public review of the RI/FS process and the proposed remedial alternatives. Table 1-1 lists the RI reports, FSs, and PPs that documented the RI/FS process for the Model Group 5 waste sites, including those sites from which no data will be collected under this SAP.

During the regulator review of the RI reports and FSs, a growing desire for additional data above that identified in the approved RI/FS work plans was identified by the EPA and Ecology. The Tri-Parties undertook an activity in fiscal years 2005 and 2006 to evaluate data needs and to reach agreement on a path forward for supplemental data collection. The initial step in this activity was to bin waste sites based on an updated understanding gained from the RIs performed under the approved work plans. The Tri-Parties identified seven bins, assigning each as a separate 'Model Group' numbered one through seven. This SAP addresses Model Group 5 waste sites, consisting of the large-area cooling-water ponds that generally are located around the outer perimeter of the 200 Areas. The cooling-water ponds tend to be shallow waste sites with relatively low contaminant concentrations.

1.3 SCOPE

The scope of this SAP is limited to collection of supplemental RI and confirmatory sampling data at Model Group 5, Large-Area Ponds, waste sites where the Tri-Parties have agreed to collect more data in support of remedial alternative decision making or to augment the decision-making process by accelerating confirmatory sampling ahead of the ROD. The QAPjP and field sampling plan (FSP) are written to apply to the RI techniques that will be employed at Model Group 5 waste sites. The data collected in accordance with this SAP are intended to augment the characterization data collected under the RI/FS work plans to refine remedial-alternative evaluation and enhance remedial decision making. Data-collection activities described in this SAP are based on the DQO process (Section 1.7).

1.4 DOCUMENT ORGANIZATION

This SAP is organized as follows.

- Chapter 1.0 summarizes DQO process results and waste site background information.
- Chapter 2.0 provides the QAPjP.
- Chapter 3.0 is the FSP for collection of additional data from vadose-zone soils of the Model Group 5, Large-Area Pond waste sites.
- Chapter 4.0 provides for project health and safety planning.
- Chapter 5.0 provides for management of investigation-derived waste (IDW).

1.5 MODEL GROUP 5 WASTE SITES BACKGROUND, DESCRIPTION, AND HISTORY OF OPERATIONS

This section provides the background, description, and history of the Model Group 5, Large-Area Pond, waste sites. This group consists of 13 waste sites comprising ponds and ditches located around the perimeter of the 200 Areas. Figure 1-1 identifies the general location on the Hanford Site of Model Group 5 waste sites. Figures 1-2 and 1-3 show the locations of the 200 West and 200 East Areas waste sites, respectively. Table 1-1 identifies the large-pond and ditch sites included in Model Group 5 and provides background and description information. These waste sites primarily received liquid-effluent waste in the form of steam condensate and cooling water from multiple facilities in the 200 Areas. This effluent typically contained low concentrations of contaminants, but occasional failure in the process systems resulted in the release of radionuclides to the cooling-water systems. Some contaminants entered the vadose zone, although they are not anticipated to have reached the aquifer beneath the waste sites. Additional information on waste sites is provided in the documents listed in Table 1-1.

Through the DQO process, it was decided that the 216-T-4A Pond would be withdrawn from Model Group 5, because this site already has undergone significant remediation, making it more appropriate for placement in Model Group 1.

1.6 CONTAMINANTS OF CONCERN

The DQO process (Appendix A) includes identification of the contaminants of potential concern (COPC) for further Model Group 5 waste site evaluation. The radiological and chemical COPCs for the Model Group 5 waste sites are a subset of the COPCs identified in RI/FS documents (Table 1-1). The DQO generally narrowed the list of COPCs for this characterization to the primary risk drivers identified in the RI/FS processes. The COPCs for each waste site are summarized in Table 1-2.

Contaminants not identified as COPCs could be reported by the analytical laboratories as detected during addition data acquisition. Such data will be evaluated against process knowledge, exposure assumptions, and regulatory standards and/or risk-based cleanup levels in support of remedial-action decision making.

1.7 DATA QUALITY OBJECTIVES

To ensure that data quality requirements are met, the sampling design in this SAP was established through the EPA's seven-step DQO process (EPA/240/B-06/001, *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4) as detailed in Appendix A. The DQO process workshops for the Model Group 5 waste sites began October 20, 2005, and the last workshop occurred September 7, 2006. The key DQO outputs are summarized in this section, including statement of the problem(s), decision rules, tolerable limits on decision errors, and sampling design. The sampling design developed in the DQO and summarized in this section has been carried forward to the FSP (Chapter 3.0).

Table 1-3 provides a concise statement of the problem to be resolved.

Table 1-4 identifies the potentially applicable or relevant and appropriate requirements (ARAR) for the Model Group 5 waste sites.

Table 1 5 identifies Model Group 5 information needs identified in DQO Step 3. These information needs are evaluated against the existing data to determine what additional data, if any, are needed to support remedial alternative decision-making.

1.7.1 Decision Rules

Decision rules are developed in DQO Step 5 from the combined results of DQO Steps 2, 3, and 4, which include development of principal study questions (PSQ), decision statements (DS), remedial-action alternatives, data needs, COPC action levels, analytical requirements, and the scale of the decisions.

The decision rules generally are developed for each DS in the form of an "IF…THEN…" statement that considers the parameters of interest (e.g., COPCs), the scale of the decision (e.g., location), the action level (e.g., COPC concentration), and the alternative action that would be taken under prescribed conditions. The Model Group 5 decision rules are shown in Table 1-6.

1.7.2 Sample Design Summary

Data-collection locations and sampling methods have been selected that resolve the DSs and provide information regarding sample parameters. A biased (nonstatistical), two-phase investigation approach is used at times to identify the horizontal and lateral extent of contamination at Model Group 5 waste sites. This investigative approach relies on observational techniques to determine appropriate locations for focused soil sampling. Field geophysical logging of direct-push probes will be used to identify where gross gamma from Cs-137, a pervasive and persistent COPC for all waste sites, exceeds logging action levels. This approach increases the likelihood of encountering the worst case conditions (i.e., maximum contaminant concentrations) for focused sampling collection.

Table 1-7 summarizes methods and key features of the data collection at pond waste sites for which existing data are not sufficient to make a remedial decision.

Figure 1-1. Location of Model Group 5 Waste Sites.

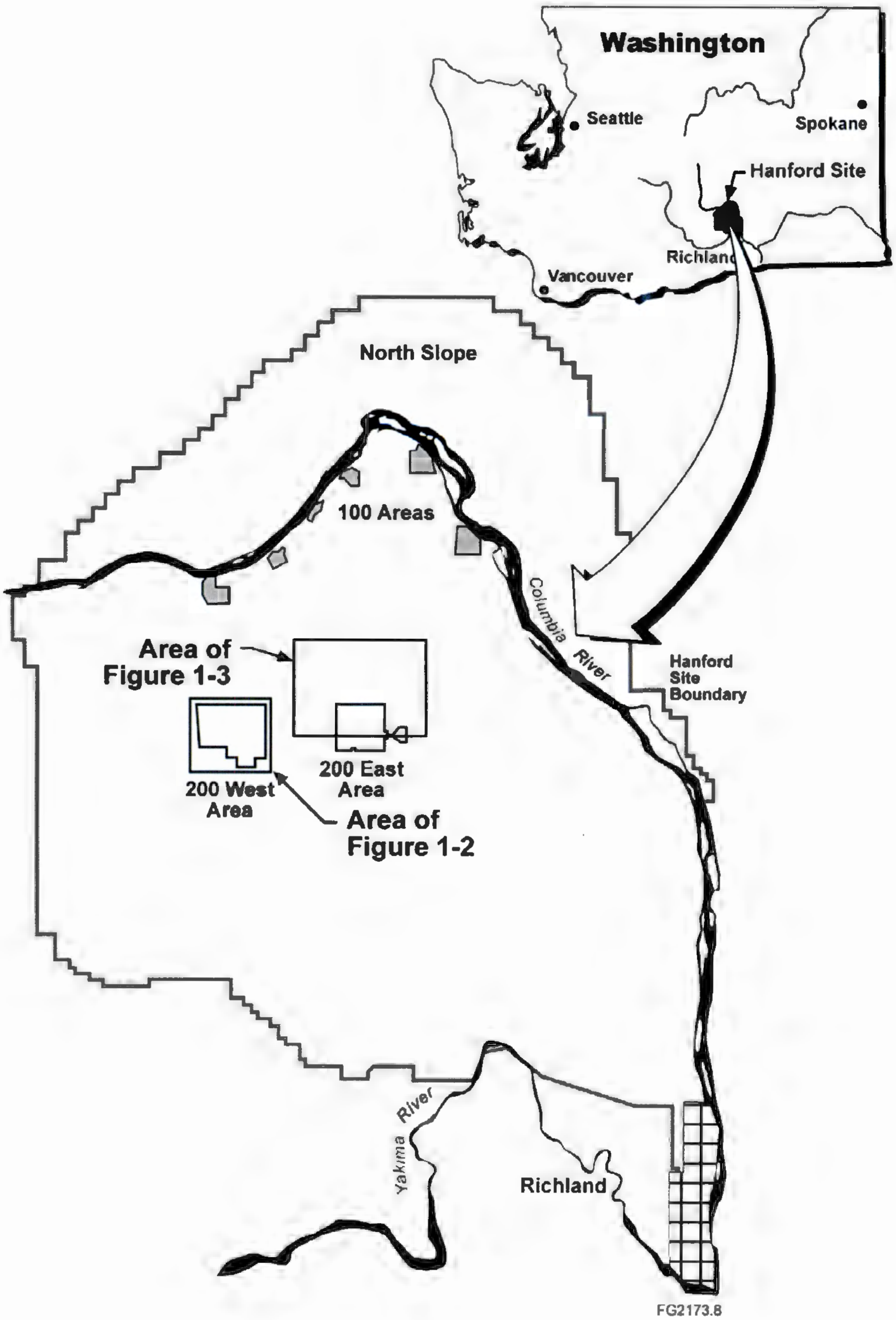


Figure 1-2. Location of 200 West Area Model Group 5 Ponds.

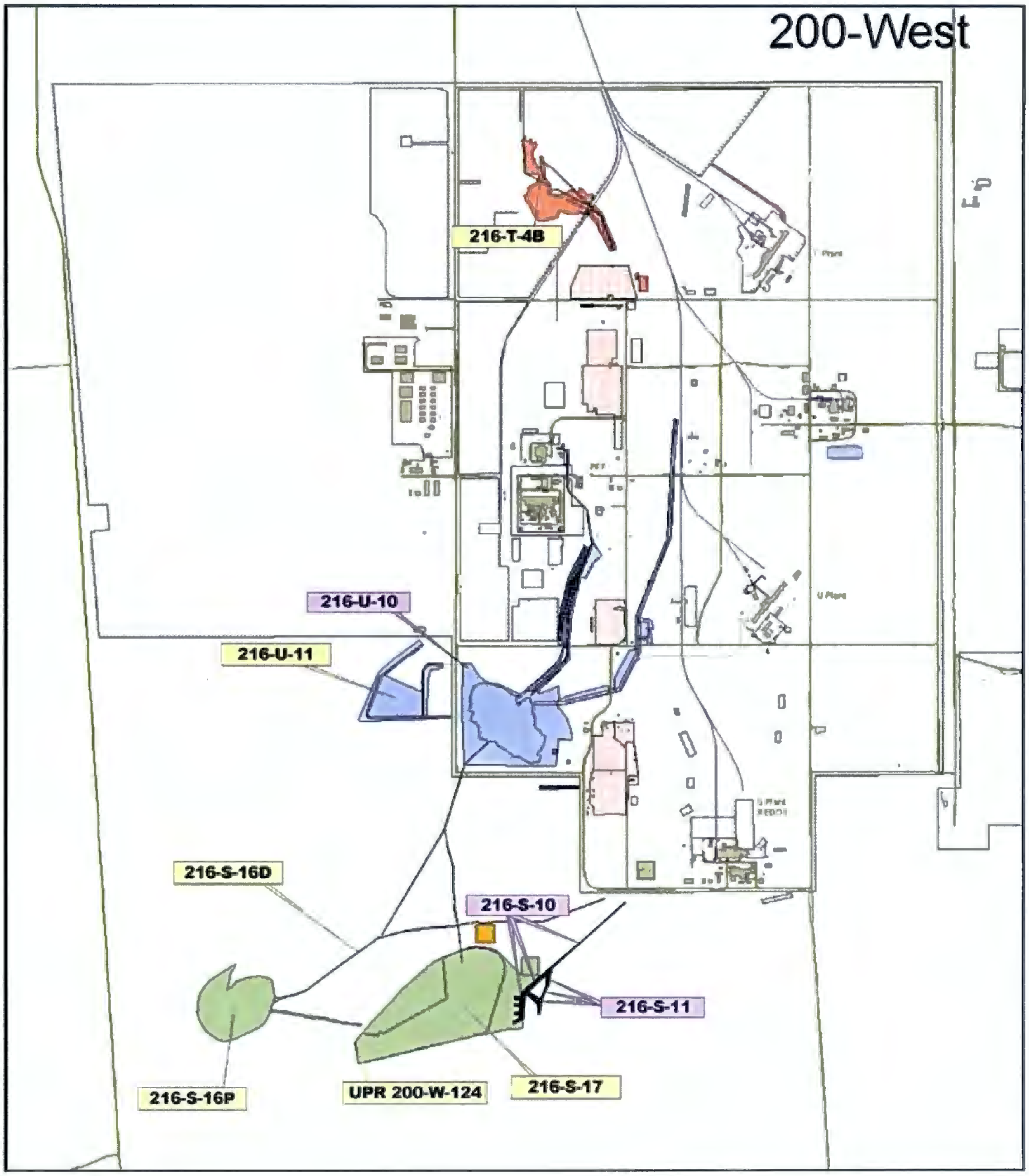


Figure 1-3. Location of 200 East Area Model Group 5 Ponds.

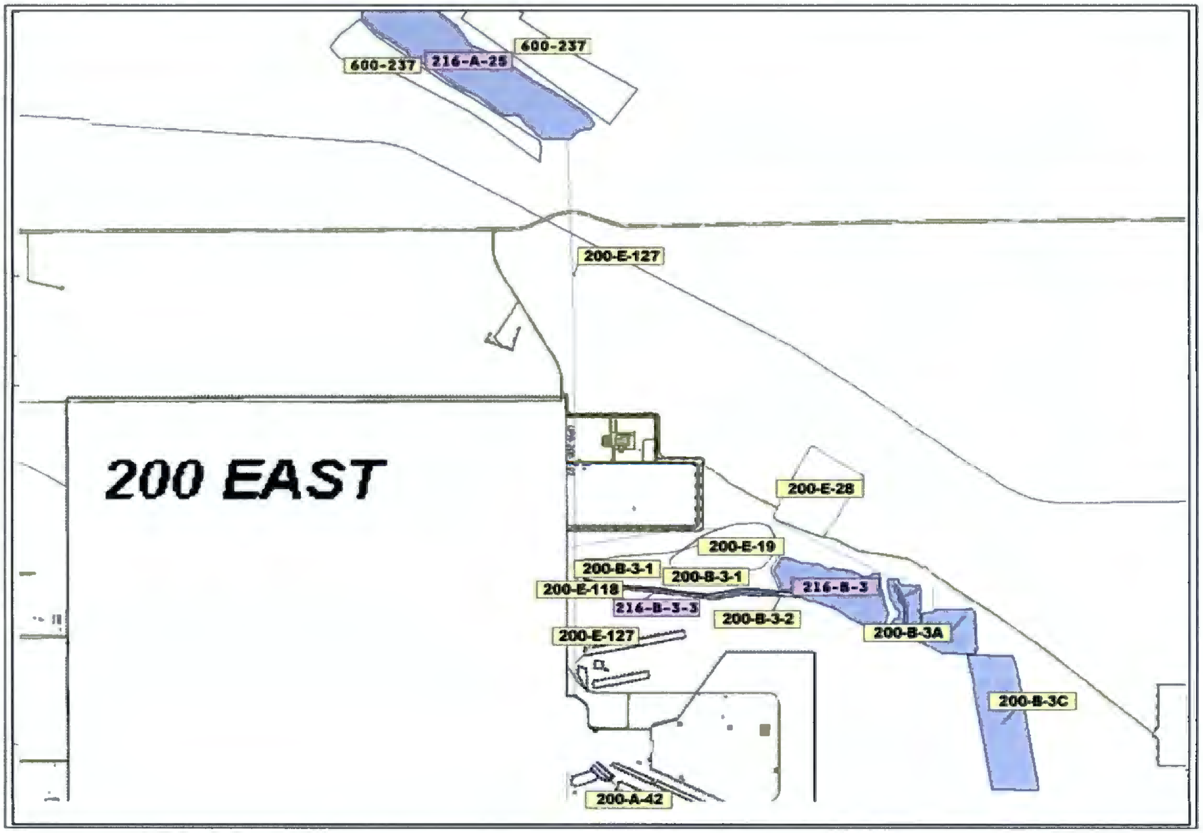


Table 1-1. Model Group 5, Large-Area Ponds, Waste Sites. (4 Pages)

Site	Source Facility/ Process	Description, Dates of Operation	Operable Unit	RI Rep Site? (Y/N)	Work Plan (DOE/ RL #)	RI Report (DOE/RL #)	FS/PP (DOE/RL#, DOE/RL#)	FS/PP Recommended Alternative
216-A-25 Pond	PUREX, B Plant	Operated from 1957 to 1987 as a 29 ha (71-acre) and 1.5 m (5 ft) deep large percolation pond. Bentonite was added to decrease percolation, and copper sulfate was added to eliminate algae and invertebrate food sources for water fowl. Backfilled and surface stabilized in 1988.		Yes				MESC
216-B-3 Pond	B Plant, PUREX	Operated from 1945 to 1994 as a 14 ha (35-acre) and 0.6 to 6 m (2 to 20 ft) percolation pond. Bentonite was added to decrease percolation. Backfilled and surface stabilized in 1994.	200-CW-1	Yes	99-07	2000-35	2002-69/ 2003-06	MESC
216-B-3A Pond	Same as 216-B-3 Main Pond	Operated from 1983 to 1994 as a 4 ha (10-acre), approx. 1 m (2 to 3 ft) deep pond. Clean closed under RCRA in 1995.		No				No-action site
216-B-3B Pond	Same as 216-B-3 Main Pond	Operated from 1983 to 1995 as a 4 ha (10-acre), approx. 1 m (2 to 3 ft) deep pond. Clean closed under RCRA in 1995.		No				No-action site
216-B-3C Pond	Same as 216-B-3 Main Pond	Operated from 1985 to 1997 as a 17 ha (141-acre), 2 to 3 m (6.6 to 10 ft) deep pond. Clean closed under RCRA in 1995.		No				No-action site
216-S-10 Pond	REDOX; the 216-S-10 Ditch fed the pond.	Operated from 1951 to 1991 as an irregular-shaped manmade pond covering 20,234 m^2 (5 acres), 2.4 m (8 ft) deep, and included four finger-leach trenches. Stabilized in 1984.	200-CS-1	Yes	99-44	2004-17	2005-63/ 2005-64	No-action site

Table 1-1. Model Group 5, Large-Area Ponds, Waste Sites. (4 Pages)

Site	Source Facility/ Process	Description, Dates of Operation	Operable Unit	RI Rep Site? (Y/N)	Work Plan (DOE/ RL #)	RI Report (DOE/RL #)	FS/PP (DOE/RL#, DOE/RL#)	FS/PP Recommended Alternative
216-S-16 Pond	Cooling water and steam condensate from REDOX; after 1973 received 216-U-10 Pond overflow via the 216-U-9 Ditch.	Operated from 1957 to 1975. Pond had four lobes separated by dikes and a leach trench that covered 125,000 m^2 (1,350,000 ft^2) and was 0.9 m (3 ft) deep. In 1975, the 216-S-16 Pond was backfilled and surface stabilized using soil from the dikes. Lobe #4 never was used.		No				Cap
216-S-17 Pond	REDOX (202-S) and 216-U-10 Pond overflow via the 216-U-9 Ditch.	Operated from 1951 to 1954. Pond was formed by earthen dikes, approximately 1 m (3.3 ft) high on the north and west side of the site, and covered 292 by 292 m (958 by 958 ft), or 6.9 to 8.5 ha (17 to 21 acres), and averaged 0.3 to 0.6 m (1 to 2 ft) depth. Copper sulfate was added to eliminate algae and invertebrate food sources for water fowl. Pond was backfilled in 1954 and stabilized again in 1984.	200-CW-2	No	99-66	2003-11	2004-24/ 2004-26	Cap
UPR-200-W-124	Cooling water from 202-S Facility process tanks	UPR was reported in 1959 and was a 305 x 9 m (1,000 x 30 ft) release from the southwest area of the 216-S-17 Pond, caused by a dike break.		No				Cap

Table 1-1. Model Group 5, Large-Area Ponds, Waste Sites. (4 Pages)

Site	Source Facility/ Process	Description, Dates of Operation	Operable Unit	RI Rep Site? (Y/N)	Work Plan (DOE/ RL #)	RI Report (DOE/RL #)	FS/PP (DOE/RL#, DOE/RL#)	FS/PP Recommended Alternative
216-T-4A Pond	T Plant – 221-T, 224-T, 242-T, 2706-T Bldgs	Operated from 1944 to 1972 as a natural surface depression in the desert floor 6.5 ha (16 acres) that received T Plant process cooling water, steam condensate, and decontamination waste. In 1972, the bottom of the original pond was scraped to a depth of 15 to 23 cm (6 to 9 in.), and the scrapings were placed in the adjacent 218-W-2A Burial Ground (Trench #27). The area was covered with clean soil in February 1973.	200-CW-4	No	99-66	2003-11	2004-24/ 2004-26	Cap
216-T-4B Pond	242-T Evaporator steam condensate and condenser cooling water; nonradioactive wastewater from 221-T air conditioning filter units and floor drains.	Operated from 1972 to 1995 and replaced the 216-T-4A Pond. It was a natural depression that received runoff from the 216-T-4-2 Ditch. Wetted size estimated at 0.6 ha (1.5 acres), 0.45 m (1.5 ft) deep. The volume of water in the new 216-T-4-2 Ditch usually was not enough to fill the pond and generally was absorbed in the ditch, leaving the pond area dry. This site is now located within the 218-W-3AE Burial Ground.		No				Cap
216-U-10 Pond	284-W, 231-Z, 234-5Z, 2723-W, 2724-W, 221-U, 224-U, 241-U-110, 242-S, 271-U, 291-Z	Operated from 1944 to 1985 as an unlined topographic depression of 12 ha (30 acres), having a variable depth. Backfilled and surface stabilized in 1985.	200-CW-5	Yes				Cap
216-U-11 Ditch	234-5Z, 291-Z, 231-Z	Operated from 1944 to 1957 as an unlined ditch of 1,375 x 1.5 m (4,510 x 5 ft), 1.8 m (6 ft) deep. Backfilled and surface stabilized in 1985 in conjunction with 216-U-10 Pond.		No				Cap

Table 1-1. Model Group 5, Large-Area Ponds, Waste Sites. (4 Pages)

Site	Source Facility/ Process	Description, Dates of Operation	Operable Unit	RI Rep Site? (Y/N)	Work Plan (DOE/ RL #)	RI Report (DOE/RL #)	FS/PP (DOE/RL#, DOE/RL#)	FS/PP Recommended Alternative

DOE/RL-99-07, *200-CW-1 Operable Unit RI/FS Work Plan and 216-B-3 RCRA TSD Unit Sampling Plan.*

DOE/RL-99-44, *200-CS-1 Operable Unit RI/FS Work Plan and RCRA TSD Unit Sampling Plan.*

DOE/RL-99-66, *Steam Condensate/Cooling Water Waste Group Operable Units RI/FS Work Plan; Includes: 200-CW-5, 200-CW-2, 200-CW-4, and 200-SC-1 Operable Units.*

DOE/RL-2000-35, *200-CW-1 Operable Unit Remedial Investigation Report.*

DOE/RL-2002-69, *Feasibility Study for the 200-CW-1 and 200-CW-3 Operable Units and the 200 North Area Waste Sites.*

DOE/RL-2003-06, *Proposed Plan for the 200-CW-1 Gable Mountain Pond/B Pond and Ditches Waste Group Operable Unit, the 200-CW-3 North Area Cooling Water Waste Group Operable Unit, and the 200 North Area Waste Sites.*

DOE/RL-2003-11, *Remedial Investigation for the 200-CW-5 U Pond/ Z Ditches Cooling Water Group, the 200-CW-2 S Pond and Ditches Cooling Water Group, the 200-CW-4 T Pond and Ditches Cooling Water Group, and the 200-CS-1 Steam Condensate Group Operable Units.*

DOE/RL-2004-17, *Remedial Investigation Report for the 200-CS-1 Chemical Sewer Group Operable Unit.*

DOE/RL-2004-24, *Feasibility Study for the 200-CW-5 (U Pond/Z Ditches Cooling Water Waste group), 200-CW-2 (S Pond and Ditches Cooling Water Waste Group), 200-CW-4 (T Pond and Ditches Cooling Water Waste Group), and 200-SC-1 (Steam Condensate Waste Group) Operable Units.*

DOE/RL-2004-26, *Proposed Plan for 200-CW-5, 200-CW-2, 200-CW-4 and 200-SC-1 Operable Units.*

DOE/RL-2005-63, *Feasibility Study for the 200-CS-1 Chemical Sewer Group Operable Unit.*

DOE/RL-2005-64, *Proposed Plan for the 200-CS-1 Chemical Sewer Group Operable Unit.*

DOE = U.S. Department of Energy.
FS = feasibility study.
MESC = maintain existing soil cover.
PP = proposed plan.
PUREX = Plutonium-Uranium Extraction Plant.
RCRA = *Resource Conservation and Recovery Act of 1976.*
REDOX = Reduction-Oxidation Plant.
RI (rep site) = remedial investigation (representative waste site).
RL = Richland Operations Office.
UPR = unplanned release.
work plan = remedial investigation/feasibility study work plan.

Table 1-2. Summary of Model Group 5 Waste Site Characterization Requirements. (2 Pages)

Site	More Data Required? (Yes/No)	Data Quality Objectives Rationale (Technical Basis)	Potential Remedy Impact? (Yes/No)	Accelerated, Confirmatory Sampling? (Yes/No)	Contaminants of Potential Concern		Data-Gathering Method
					Nonradiological	Radiological	
216-A-25 Pond	Yes	Need data at overflow area to reconcile historical flyover survey findings.	Yes	Yes [a]	NR	Cs-137	Geophysical logging of direct-push probes
216-B-3 Pond	Yes	Data insufficient to confirm a partial removal alternative as a possible means to reduce site risk.	Yes	Yes [a]	Cadmium, lead, mercury [b]	Cs-137 [b]	Geophysical logging of direct-push probes and soil sampling
216-B-3A Pond	No	N/A	N/A	N/A	NR	NR	N/A
216-B-3B Pond	No	N/A	N/A	N/A	NR	NR	N/A
216-B-3C Pond	No	N/A	N/A	N/A	NR	NR	N/A
216-S-10 Pond	No	N/A	N/A	N/A	NR	NR	N/A
216-S-16 Pond	Yes	More data needed to identify spatial distribution and concentrations of contaminants of potential concern.	Yes	Yes	Antimony, cadmium, manganese, selenium, uranium (total), silver, thallium, toluene, fluoride, cyanide, nitrate [c]	Cs-137, Eu-154, Sr-90, Tc-99, Np-237, Pu-239/240, Am-241, and U-238 [c]	Geophysical logging of direct-push probes and soil sampling
216-S-17 Pond	Yes	No site-specific historical data available.	Yes	Yes	Antimony, cadmium, manganese, selenium, uranium (total), silver, thallium, toluene, fluoride, cyanide, nitrate [c]	Cs-137, Eu-154, Sr-90, Tc-99, Np-237, Pu-239/240, Am-241, and U-238 [c]	Geophysical logging of direct-push probes and soil sampling.
UPR-200-W-124	TBD	Dependent on the results of the 216-S-17 Pond investigation [d].	No	No	NR	Cs-137	Geophysical logging of direct-push probes
216-T-4B Pond	Yes	No site-specific historical data available.	Yes	Yes	Antimony, cadmium, manganese, selenium, uranium (total), silver, thallium, toluene, fluoride, cyanide, nitrate [c]	Cs-137, Eu-154, Sr-90, Tc-99, Np-237, Pu-239/240, Am-241, and U-238 [c]	Geophysical logging of direct-push probes and soil sampling.

Table 1-2. Summary of Model Group 5 Waste Site Characterization Requirements. (2 Pages)

Site	More Data Required? (Yes/No)	Data Quality Objectives Rationale (Technical Basis)	Potential Remedy Impact? (Yes/No)	Accelerated, Confirmatory Sampling? (Yes/No)	Contaminants of Potential Concern		Data-Gathering Method
					Nonradiological	Radiological	
216-U-10 Pond	Yes	Borehole, test pits, and push probes will help resolve prior data quality issues and help evaluate partial removal alternative.	Yes	Yes	Antimony, cadmium, manganese, selenium, uranium (total), silver, thallium, toluene, fluoride, cyanide, nitrate	Cs-137, Eu-154, Sr-90, Tc-99, Np-237, Pu-239/240, Am-241, and U-238	Geophysical logging of direct-push probes and soil sampling.
216-U-11 Ditch	Yes	More data needed to identify the lateral extent of contamination.	Yes	Yes	NA	Cs-137	Geophysical logging of direct-push probes

[a] Confirmatory sampling usually not required for waste sites where the Maintain Existing Soil Cover/Monitored Natural Attenuation/Institutional Control alternative will be implemented (Table 1-1).

[b] Because of the large body of characterization data available for the representative 216-B-3 Pond waste site, B Pond-specific contaminants of potential concern for this action are represented by the more focused list of contaminants of potential concern from Table 5-1 of DOE/RL-2002-69, *Feasibility Study for the 200-CW-1 and 200-CW-3 Operable Units and the 200 North Area Waste Sites*.

[c] This waste site is analogous to the well-characterized, representative 216-U-10 Pond waste site. Because of the absence of data for this analogous waste site, as a conservative measure, the list of 216-U-10 Pond contaminants of potential concern in DOE/RL-2003-11, *Remedial Investigation for the 200-CW-5 U Pond/ Z Ditches Cooling Water Group, the 200-CW-2 S Pond and Ditches Cooling Water Group, the 200-CW-4 T Pond and Ditches Cooling Water Group, and the 200-CS-1 Steam Condensate Group Operable Units*, Table 6-1, are used, with the inclusion of U-238 (identified in the *Waste Information Data System* database), fluoride and cyanide (identified through STOMP modeling (PNNL-12028, *STOMP Subsurface Transport Over Multiple Phases, Version 2.0, Application Guide*), and Pu-239/240 and Am-241 (identified by earlier 216-U-11 Ditch sampling).

[d] See Chapter 3.0, Table 3-1, for conditions under which data would be gathered at this unplanned release site.

NA = not applicable. NR = not required. TBD = to be determined.

Table 1-3. Concise Statement of the Problem.

The problem is that to complete remedial alternatives evaluation in the feasibility study and final remedial decision making for some of the Model Group 5, Large-Area Ponds waste sites, supplemental data are needed.

Table 1-4. Potentially Applicable or Relevant and Appropriate Requirements. (2 Pages)

Depth Interval For Compliance	Potential Applicable or Relevant and Appropriate Requirements	Action Levels
Radionuclides Inside the 200 Area Land-Use Boundary (Industrial Land Use) [a]		
Shallow zone (0 to 4.6 m [0 to 15 ft] bgs)	Human health; 10^{-4} to 10^{-6} risk range per CERCLA in 40 CFR 300, interpreted by EPA as 15 mrem/yr above background; OSWER 9200.4-18 (TBC) guidance on cleanup levels.	Contaminant-specific; RESRAD modeling [b]
	Ecological – ANL, 2006, *RESRAD-BIOTA*, Version 1.2 Software	
Deep zone (ground surface to groundwater)	4 mrem/yr above background to groundwater, or no additional groundwater degradation.	Maximum contamination levels, State and Federal ambient water quality control criteria; alternatively, site-specific modeling using STOMP model
Nonradiological Constituents Inside the 200 Area Land-Use Boundary (Industrial Land Use) [a]		
Shallow zone (0 to 4.6 m [0 to 15 ft] bgs)	Human health - WAC 173-340-745(5) Method C	Chemical specific (with contaminant-specific variations)
	Ecological – WAC 173-340-7493 (WAC 173-340-900, Table 749-3)	Chemical specific
Deep zone (ground surface to groundwater)	WAC 173-340-747(4) Method B criteria	Fixed-parameter three-phase partitioning model (Equation 747-1); alternatively, site-specific modeling using STOMP model
Radionuclides Outside the 200 Area Land-Use Boundary (Conservation [Mining]) [a]		
Shallow zone (0 to 4.6 m [0 to 15 ft] bgs)	Human health; 10^{-4} to 10^{-6} risk range per CERCLA in 40 CFR 300, interpreted by EPA as 15 mrem/yr above background; OSWER 9200.4-18 (TBC) guidance on cleanup levels.	Contaminant-specific; RESRAD modeling [b]
	Ecological – ANL, 2006, *RESRAD-BIOTA*, Version 1.2 Software	
Deep zone (ground surface to groundwater)	4 mrem/yr above background to groundwater, or no additional groundwater degradation.	Maximum contamination levels, State and Federal ambient water quality control criteria; alternatively, site-specific modeling using STOMP model
Nonradiological Constituents Outside the 200 Area Land-Use Boundary (Conservation [Mining]) [a]		
Shallow zone (0 to 4.6 m [0 to 15 ft] bgs)	Human health - WAC 173-340-740(3) Method B	Chemical specific (with contaminant-specific variations)
	Ecological – WAC 173-340-7493 (WAC 173-340-900, Table 749-3)	Chemical specific
Deep zone (ground surface to groundwater)	WAC 173-340-747(4) Method B criteria	Fixed-parameter three-phase partitioning model (Equation 747-1); alternatively, site-specific modeling using STOMP model

[a] DOE/EIS-0222-F, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement*, as modified by the risk framework. Waste sites near the fringe of the Core Zone Boundary may be subject to a residential use scenario.

[b] The RESidual RADioactivity dose model (RESRAD) (ANL, 2002, *RESRAD for Windows*, Version 6.21) has been used for similar waste sites and will be used as a minimum for direct exposure. If more appropriate models are developed, they will be evaluated for use.

Table 1-4. Potentially Applicable or Relevant and Appropriate Requirements. (2 Pages)

Depth Interval For Compliance	Potential Applicable or Relevant and Appropriate Requirements	Action Levels

40 CFR 300 = "National Oil and Hazardous Substances Pollution Contingency Plan."
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980.*
OSWER 9200.4-18 = EPA, 1997, *Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination.*
RESRAD-BIOTA = ANL, 2006, *RESRAD-BIOTA*, Version 1.2 Software.
STOMP = PNNL-12028, *STOMP Subsurface Transport Over Multiple Phases, Version 2.0, Application Guide.*
WAC 173-340-740(3) Method B = "Unrestricted Land Use Soil Cleanup Standards," "Method B Soil Cleanup Levels for Unrestricted Land Use."
WAC 173-340-745(5) Method C = "Soil Cleanup Standards for Industrial Properties," "Method C Industrial Soil Cleanup Levels."
WAC 173-340-747(4) Method B criteria = "Deriving Soil Concentrations for Ground Water Protection," "Fixed Parameter Three-Phase Partitioning Model."
WAC 173-340-900, "Tables."
WAC 173-340-7493 = "Site-Specific Terrestrial Ecological Evaluation Procedures."

bgs = below ground surface.
EPA = U.S. Environmental Protection Agency.
TBC = to be considered.

Table 1-5. Required Information and Reference Sources. (2 Pages)

PSQ # / PS	Required Information Category	Reference Source	Are Additional Data Required to Support RI/FS Process? [Yes [a] /No]											
			216-A-25	216-B-3	216-B-3A	216-B-3B	216-B-3C	216-S-10	216-S-16	216-S-17	UPR-200-W-124	216-T-4B	216-U-10	216-U-11
1	Soil radiological data	See the following discussion for information used to formulate table responses.	Y	Y	N[b]	N[b]	N[b]	N	Y	Y	TBD	Y	Y	Y
2	Soil non-radiological sample data	See the following discussion for information used to formulate table responses.	N	Y	N	N	N	N	Y	Y	N	Y	Y	N
PS	Physical properties moisture content, particle size distribution, and lithology	*Hydrogeologic Model for the 200-East Groundwater Aggregate Area*, WHC-SD-EN-TI-019, Rev. 0. Presents site-specific data for 200 East Area that can be used to calculate soil density, hydraulic conductivity, and porosity.	N	N[c]	N	N	N	-	-	-	-	-	-	-
		Hydrogeologic Model for the 200-West Groundwater Aggregate Area, WHC-SD-EN-TI-014, Rev. 0. Presents site-specific data for 200 West Area that can be used to calculate soil density, hydraulic conductivity, and porosity.	-	-	-	-	-	N	N[d]	N[d]	N	N	N	N

Table 1-5. Required Information and Reference Sources. (2 Pages)

PSQ # / PS	Required Information Category	Reference Source	Are Additional Data Required to Support RI/FS Process? [Yes [a] /No]											
			216-A-25	216-B-3	216-B-3A	216-B-3B	216-B-3C	216-S-10	216-S-16	216-S-17	UPR-200-W-124	216-T-4B	216-U-10	216-U-11

[a] Yes responses mean that more data will be collected.
[b] Radiological data are sufficient based on further evaluation of radiological sample analysis indicating that the analysis met detection limits.
[c] This unplanned release is contiguous with the 216-S-17 Pond; unplanned release characterization will be coordinated with 216-S-17 Pond data collection, and the need to collect UPR data will be determined by the results of the 216-S-17 Pond characterization.
[d] Analysis of soil samples for physical properties will be required, if soil sampling is indicated by geophysical logging and if physical property data do not exist.

N/A = not applicable.
PS = problem statement.
PSQ = principal study question.
RI/FS = remedial investigation/feasibility study.

Table 1-6. Decision Rules.

DR #	Decision Rule
1	If the activity of radionuclides (as estimated by the 95% upper confidence limit of the mean, or mean, maximum, or detected values) large-area pond vadose-zone soils results in a direct radiological exposure dose rate that exceeds the human health, groundwater, and/or ecological protection preliminary action levels for rural/residential (unrestricted surface use outside the core zone) and/or industrial (waste management) exposure scenarios, based on the site contaminant distribution model and RESRAD modeling, then an appropriate action will be selected from Table A-2.
2	If the concentrations of nonradiological constituents (as estimated by the 95% upper confidence limit of the mean, mean, maximum, or detected values) in large-area pond vadose-zone soils exceed the preliminary action levels for human health, groundwater, and/or ecological protection for rural/residential (unrestricted surface use outside the core zone) and/or industrial (waste management) exposure scenarios, then an appropriate action will be selected from Table A-2.

DR = decision rule.
RESRAD (ANL, 2002, *RESRAD for Windows*, Version 6.21).

Table 1-7. Summary Sampling Design.

Planned Survey or Analytical Methodology	Key Features of Design
216-A-25 Pond	
Geophysical Logging	Specific location/area of concern: Determine general extent of contamination at the stabilized, secondary overflow area emanating from the northwest corner of the stabilized primary overflow section by installing two direct-pushes into overflow area soil and geophysically log pushes using small-diameter spectral-gamma instruments..
216-B-3 Pond	
Geophysical Logging	Specific location/area of concern: Determine the nature and extent of contamination emanating radially from the pond inlet by installing direct-pushes into pond soil surrounding the BP-1 Test-Pit hotspot and geophysically log pushes using small-diameter spectral-gamma instruments.
Soil Sampling	Sample soil along the transect with the highest Cs-137 concentration, based on geophysical logging results.
216-S-16 Pond	
Geophysical Logging	Specific location/area of concern: Determine the nature and extent of contamination emanating radially from the pond inlet through the inlet channel and all four pond lobes by installing 21 direct pushes into pond soil, beginning at the pond inlet and geophysically log pushes using small-diameter spectral-gamma instruments.
Soil Sampling	Collect a minimum of one soil sample from worst case location and depth, based on geophysical logging results.
216-S-17 Pond	
Geophysical Logging	Specific location/area of concern: Determine nature and extent of contamination emanating radially from the pond inlet by installing 15 direct-pushes into pond soil, beginning at the pond inlet and geophysically log pushes using small-diameter spectral-gamma instruments.
Soil Sampling	Collect a minimum of one soil sample from worst case location and depth, based on geophysical logging results.
UPR-200-W-124 (overflow area of the 216-S-17 Pond)	
Geophysical Logging	Specific location/area of concern: Determine nature and extent of contamination emanating from the dike overflow at the southwest corner of the pond by installing direct pushes as needed, in coordination with 216-S-17 Pond characterization and geophysically log pushes using small-diameter spectral-gamma instruments.
216-T-4B Pond	
Geophysical Logging	Specific location/area of concern: Determine general extent of contamination in the primary pond location and the ditch that fed the pond by installing two direct-pushes into ditch soil and two direct-pushes into pond soil and geophysically log pushes using small-diameter spectral-gamma instruments.
Soil Sampling	Collect one soil sample from the worst case location where Cs-137 concentration exceeds the Cs-137 logging action level.
216-U-10 Pond	
Geophysical Logging	Specific location/area of concern: Determine general extent of contamination in the primary pond location, contamination at the pond bottom (i.e., organic mat), and contamination at borehole depth by installing eight direct-pushes into ditch soil. Install one borehole to resolve prior data quality issues (Table 1-2). Geophysically log pushes and borehole using spectral-gamma logging instruments.
Soil Sampling	Direct-push probe sampling: If Cs-137 concentrations exceed the Cs-137 logging action level, collect one (1) soil sample from the worst case location. Test-pit sampling: Install three (3) test pits to characterize contamination at the pond bottom (i.e., organic mat) and sample at and below the organic mat at each pit for a total of six (6) samples. Borehole sampling: Collect one (1) sample at depth, at a minimum.
216-U-11 Ditch	
Geophysical Logging	Specific location/area of concern: Determine general extent of contamination in the primary ditch sections and in the shallow overflow area between the ditch sections by installing 14 direct pushes in ditch soil and geophysically log pushes using small-diameter spectral-gamma instruments.

2.0 QUALITY ASSURANCE PROJECT PLAN

The QAPjP establishes the quality requirements for environmental data collection, including sampling, field measurements, and laboratory analysis. This QAPjP complies with the requirements of the following:

- DOE O 414.1C, *Quality Assurance*
- 10 CFR 830 Subpart A, "Quality Assurance Requirements"
- EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5, as amended.

The following sections describe the quality requirements and controls applicable to this investigation.

2.1 PROJECT MANAGEMENT

This section addresses the basic areas of project management, and it ensures that the project has a defined goal, that the participants understand the goal and approach to be used, and that the planned outputs have been appropriately documented.

2.1.1 Project/Task Organization

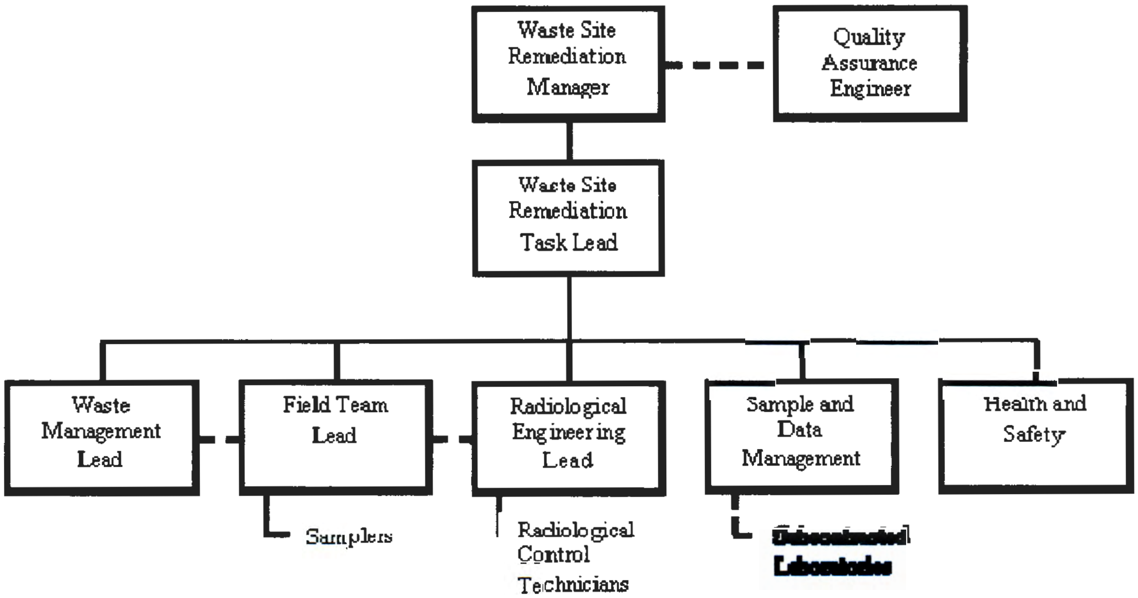
The Project Hanford Management Contractor is responsible for planning, coordinating, sampling, preparing, packaging, and shipping soil samples to the laboratory. The project organization is described in the subsections that follow and is shown graphically below.

2.1.1.1 Waste Site Remediation Manager

The Waste Site Remediation Manager provides oversight for all activities and coordinates with RL and the regulators in support of sampling activities. In addition, the manager provides support to the Waste Site Remediation Task Lead to ensure that the work is performed safely and cost-effectively. The Waste Site Remediation Manager maintains the approved QAPjP.

2.1.1.2 Waste Site Remediation Task Lead

The Waste Site Remediation Task Lead is responsible for direct management of sampling documents and requirements, field activities, and subcontracted tasks. The task lead works closely with quality assurance (QA), health and safety, and the Field Team Lead to integrate these and the other lead disciplines in planning and implementing the work scope. The task lead also coordinates with, and reports to, RL and the Project Hanford Management Contractor on all sampling activities. The task lead supports RL in coordinating sampling activities with the regulators.



2.1.1.3 Quality Assurance Engineer

The Quality Assurance Engineer is matrixed to the Waste Site Remediation Manager and is responsible for QA issues on the project. Responsibilities include oversight of project QA requirements implementation, review of project documents including SAPs (and the QAPjP), and participation in QA assessments on sample collection and analysis activities, as appropriate.

2.1.1.4 Waste Management Lead

The Waste Management Lead communicates policies and procedures and ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost-effective manner. Other responsibilities include identifying waste management sampling/characterization requirements to ensure regulatory compliance interpretation of the characterization data to generate waste designations, profiles, and other documents that confirm compliance with waste acceptance criteria.

2.1.1.5 Field Team Lead

The Field Team Lead has the overall responsibility for the planning, coordination, and execution of the field characterization activities. Specific responsibilities include converting the sampling design requirements into field task instructions that provide specific direction for field activities. Responsibilities also include directing training, mock-ups, and practice sessions with field personnel to ensure that the sampling design is understood and can be performed as specified. The Field Team Lead communicates with the Waste Site Remediation Task Lead to identify field constraints that could affect the sampling design. In addition, the Field Team Lead directs the procurement and installation of materials and equipment needed to support the field work.

The Field Team Lead oversees field sampling activities that include sample collection, packaging, provision of certified clean sampling bottles/containers, documentation of sampling activities in controlled logbooks, chain-of-custody documentation, and packaging and transportation of samples to the laboratory or shipping center.

The Field Team Lead, samplers, and others responsible for implementation of this SAP and QAPjP will be provided with current copies of this document and any revisions thereto.

2.1.1.6 Radiological Engineering Lead

The Radiological Engineering Lead is responsible for the radiological engineering and health physics support to the project. Specific responsibilities include conducting as-low-as-reasonably-achievable (ALARA) reviews, exposure and release modeling, and radiological controls optimization for all work planning. In addition, radiological hazards are identified and appropriate controls are implemented to maintain worker exposures to the hazards ALARA. The Radiological Engineering Lead interfaces with the project Health and Safety representative and plans and directs radiological control technician support for all activities.

2.1.1.7 Sample and Data Management

The Sample and Data Management organization selects the laboratories that perform the analyses. This organization also ensures that the laboratories conform to Hanford Site internal laboratory QA requirements, or their equivalent, as approved by RL, the EPA, and Ecology. Sample and Data Management receives the analytical data from the laboratories, makes the data entry into the *Hanford Environmental Information System* database (HEIS), and arranges for data validation. Validation will be performed on completed data packages by Project Hanford Management Contractor (PHMC) personnel or by an independent contractor qualified to perform validation by meeting the requirements of applicable site procedures.

2.1.1.8 Health and Safety Representative

Responsibilities include coordination of industrial health and safety support to the project as carried out through health and safety plans, activity job hazard analyses, and other pertinent safety documents required by Federal regulation or by internal PHMC work requirements. In addition, assistance is provided to project personnel in complying with applicable health and safety standards and requirements. Personal protective clothing requirements are coordinated with Radiological Engineering.

2.1.2 Problem Definition/Background

Chapter 1.0 of this SAP describes the background and current understanding of the waste sites. During the RI/FS processes for the OUs that contain the Model Group 5 waste sites, decision makers expressed concerns regarding uncertainties associated with selection of preferred remedial alternatives for some large-area ponds waste sites. The uncertainties generally were associated with the uncharacterized (analogous) waste sites but also included some waste sites characterized as 'representative' waste sites. The problem is that supplemental data are needed to support remedial alternative evaluation and final remedial decision making for some Model Group 5, Large-Area Ponds, waste sites. Data collected under this SAP will be used to support

RI/FS process evaluation of remedial alternatives for the Model Group 5, Large-Area Ponds, waste sites.

2.1.3 Project/Task Description

This activity is to collect supplemental data at the following Model Group 5 waste sites: 216-A-25 Pond, 216-B-3 Pond, 216-S-10 Pond, 216-S-16 Pond, 216-S-17 Pond (and associated UPR-200-W-124), 216-T-4A Pond, 216-T-4B Pond, 216-U-10 Pond, and the 216-U-11 Ditch. Direct pushes and a single borehole will be installed to collect data through geophysical logging and sampling in accordance with this SAP. These activities support Tri-Party Agreement (Ecology et al. 1989) milestone M-15 requirements for completion of the RI/FS processes for these waste sites by December 31, 2011. Data acquired from the geophysical logging and analytical sampling described in this SAP will augment data initially collected under the respective OU Work Plans (Table 1-1). These data will meet the needs for supplemental data necessary to complete remedial decision making for the Model Group 5, Large-Area Ponds, waste sites. Field characterization activities will be performed at selected pond waste sites. A two-phase investigation approach has been developed that relies on geophysical logging to determine appropriate locations for soil sampling. This approach increases the likelihood of encountering maximum contaminant concentrations (i.e., worst case conditions) for focused sampling collection and laboratory analysis.

2.1.4 Quality Objectives and Criteria

Quality objectives and criteria for analytical soil measurement data are presented in Tables 2-1 (radionuclides) and 2-2 (nonradionuclides) and for observational data from geophysical logging in Table 2-3 (gamma logging). Analysis of soil physical properties will be performed according to American Society for Testing and Materials procedures, if applicable.

The QA objective of this plan is to develop implementation guidance that will provide data of known and appropriate quality. Data quality is assessed by accuracy and precision, by evaluation against identified data quality objectives, and by evaluation against the work activities. The applicable quality control (QC) guidelines and target quantitation limits for assessing data quality are dictated by the intended use of the data and the nature of the analytical method. Each of these is addressed below.

2.1.4.1 Accuracy

Accuracy is an assessment of the closeness of the measured value to the true value. Accuracy of chemical test results is assessed by spiking samples with known standards and establishing the average recovery. A matrix spike is the addition to a sample of a known amount of a standard compound that is similar to the compounds being measured. Radionuclide measurements that require chemical separations use this technique to measure method performance. For radionuclide measurements that are analyzed by gamma spectroscopy, laboratories typically compare results of blind audit samples against known standards to establish accuracy. Validity of calibrations is evaluated by comparing results from the measurement of a standard to known values and/or by generating in-house statistical limits based on three standard deviations

(+/-3 SD). Tables 2-1 and 2-2 list the accuracy requirements for fixed laboratory analyses for the project.

2.1.4.2 Precision

Precision is a measure of the data spread when more than one measurement has been taken on the same sample. Precision can be expressed as the relative percent difference for duplicate measurements. Analytical precision requirements for fixed laboratory analyses are listed in Tables 2-1 and 2-2.

2.1.4.3 Detection Limits

Preliminary action levels are identified to ensure that laboratory detection limits are established that can provide data at concentrations low enough for comparison against remedial-action levels established during the RI/FS process via ARARs. Quantitation limits are functions of the analytical method used to provide the data and the quantity of the sample available for analyses. These are essentially the detection limits for the soil and QC sample analytes that are listed in Tables 2-1 and 2-2 as required target quantitation limits and must be lower than the preliminary action level to ensure that the data are useable.

2.1.5 Special Training/Certification

Typical training or qualification requirements have been instituted by the Project Hanford Management Contractor team to meet training requirements imposed by the Project Hanford Management Contract, regulations, DOE orders, contractor requirements documents, American National Standards Institute/American Society of Mechanical Engineers standards, *Washington Administrative Code*, etc. Following are two examples.

- Training or certification requirements needed by sampling personnel will be in accordance with requirements and procedures established to ensure Hanford Site analytical quality.
- Qualification requirements for radiological control technicians are established by the Radiation Protection Program; radiological control technicians assigned to these activities will be qualified through the prescribed training program and will undergo ongoing training and qualification activities.

The environmental safety and health training program provides workers with the knowledge and skills necessary to safely execute assigned duties. Field personnel typically will have completed the following training before starting work:

- Occupational Safety and Health Administration 40-hour hazardous waste worker training and supervised 24-hour hazardous waste site experience
- 8-hour hazardous waste worker refresher training (as required)
- Hanford general employee radiation training

- Radiological worker training.

A graded approach is used to ensure that workers receive a level of training commensurate with their responsibilities that complies with applicable DOE orders and government regulations. Specialized employee training includes pre-job briefings, on-the-job training, emergency preparedness, plan-of-the-day activities, and facility/worksite orientations.

Field personnel training will be documented, and records will be kept on file by the training organization.

The Field Team Lead will be responsible for ensuring the appropriate level of training of sampling personnel and for directing appropriate specific training. The Field Team Lead will direct training sessions, mockups, and practice sessions to ensure that the sampling activity is fully understood and will be performed as specified. Any specialized training will be noted in the field logbook. The QA engineer can indirectly assist in ensuring that samplers have the appropriate level of training through ensuring adherence to QA program training requirements.

2.1.6 Documentation and Records

The Waste Site Remediation Task Lead ensures that the Field Team Lead, samplers, and others responsible for implementation of this SAP and QAPjP are provided with current copies of this document and any revisions thereto.

Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes that comprise a collection of document control systems and processes that use a graded approach for the preparation, review, approval, distribution, use, revision, storage/retention, retrieval, disposition, and protection of documents and records generated or received in support of Fluor Hanford work.

All information pertinent to field sampling and analysis will be recorded in field checklists and bound logbooks in accordance with existing sample-collection protocols.. The sampling team will be responsible for recording all relevant sampling information in the logbooks. Entries made in the logbook will be dated and signed by the individual who made the entry. Correction of erroneous logbook entries will be by a single line through the incorrect information, with the initial and date of the person making the correction. Program requirements for managing the generation, identification, transfer, protection, storage, retention, retrieval, and disposition of records within the PHMC also will be followed.

Data collected through this sampling will support development and evaluation of remedial alternatives through the FS process for the respective Model Group 5 waste site OUs. The evaluation will be documented in the FS and summarized in the proposed plan. These documents will be prepared in accordance with *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) requirements and guidance and with the Tri-Party Agreement (Ecology et al. 1989). In addition to these formal documents, a contractor-level document will be produced to summarize the field activities and to capture in a referenceable form the field screening and geophysical data collected from the drilling or direct-push activities (e.g., borehole and direct-push logging summary reports). Field summary report(s) will be consistent with similar documents prepared for other RI characterization sites. Any additional data needs identified through a DQO process following receipt of waste site data collected in accordance with this SAP will be documented in a revision to this SAP.

Primary documents under the Tri-Party Agreement, such as the RI Report, FS, and proposed plan, will be submitted to the Administrative Record. All other documentation will be prepared, approved, and maintained in accordance with RL and contractor requirements for these processes.

2.2 DATA GENERATION AND ACQUISITION

This section presents the requirements for sampling methods, sample handling and custody, analytical methods, and field and laboratory QC. Instrument calibration, maintenance supply inspection, and data management requirements also are addressed.

2.2.1 Geophysical Logging and Soil-Sampling Process Design

Geophysical logging and soil-sampling locations are identified in this SAP in the FSP (Chapter 3.0). These represent proposed locations could be influenced by site-specific conditions, such as physical obstructions and/or limited sample volume or inability to obtain a sample. Samples that cannot be collected because of field conditions will be noted in the daily field sampling log. Sample locations also may be adjusted, based on visual or field-screening methods that may indicate a better sample location to meet DQOs (such as higher concentrations at a different depth or indication of increased moisture or staining). Additional depth locations may be sampled based on the judgment of field personnel and the real-time field conditions. Minor changes, including changes in sample locations because of physical obstructions, changes in location to better meet DQOs, or additions of sample depth(s), can be made and documented in the field. More significant changes in sample locations that do not impact the DQOs will require notification and approval of the Waste Site Remediation Task Lead. Changes to sample locations that could result in impacts to meeting the DQOs will require decision maker concurrence.

Sample design details are presented in Chapter 3.0. The sample design, sample matrixes, parameters, and rationale are presented on a site-specific basis in Table 3-1. The number and types of samples, including location and frequency and data to be collected are identified in Table 3-2 and in the Chapter 3.0 figures.

2.2.2 Geophysical Logging and Soil-Sampling Methods

Methods for installation of direct pushes, borehole drilling, sample collection, cleaning and decontamination of drilling and sampling collection equipment, and sample handling details are provided in Chapter 3.0. The sampling methods described are based on approved sampling and logging procedures that have been used for similar field-characterization activities. The sampling procedures are available for RL and EPA use.

The Field Team Lead and the Waste Site Remediation Task Lead are responsible for ensuring that all field procedures are followed completely and that field sampling personnel are adequately trained to perform sampling activities under this SAP. The Waste Site Remediation Lead, or the Field Team Lead at the discretion of the Waste Site Remediation Task Lead, must document all deviations from procedures or other problems pertaining to sample collection, chain of custody, contaminants of potential concern, sample transport, or noncompliant monitoring. As appropriate, such deviations or problems will be documented in the field logbook or in nonconformance report forms in accordance with internal corrective action procedures. They will be responsible for communicating field corrective action requirements and for ensuring that immediate corrective actions are applied to field activities.

Soil sample preservation, containers, and holding times for chemical and radiological analytes of interest and physical property tests are presented in Table 2-4. Final sample collection requirements will be identified on the Sampling Authorization Form.

2.2.3 Sample Handling and Custody

Level I EPA pre-cleaned sample containers will be used for soil samples collected for radiological and nonradiological analyses. Container sizes may vary depending on laboratory-specific volumes/requirements for meeting analytical detection limits. If, however, the dose rate on the outside of a sample jar or the curie content exceeds levels acceptable by an offsite laboratory, the Sample and Data Management Lead and Waste Site Remediation Task Lead can send smaller volumes to the laboratory after consultation with Project Hanford Management Contractor Sample and Data Management to determine acceptable volumes. Preliminary container types and volumes are identified in Table 2-4. The final types and volumes will be indicated on the Sampling Authorization Form.

The Fluor Hanford *Sample Data Tracking* database will be used to track the samples from the point of collection through the laboratory analysis process. The HEIS database is the repository for the laboratory analytical results. The HEIS sample numbers will be issued to the sampling organization for this project. Each radiological/nonradiological and physical properties sample will be identified and labeled with a unique HEIS sample number. The sample location, depth, and corresponding HEIS number will be documented in the sampler's field logbook.

Each sample container will be labeled with the following information, using a waterproof marker on firmly affixed, water-resistant labels:

- Sampling Authorization Form
- HEIS number
- Sample collection date/time
- Name of person collecting the sample
- Analysis required
- Preservation method (if applicable).

Sample custody will be maintained in accordance with existing Hanford Site protocols. The custody of samples will be maintained from the time the samples are collected until the ultimate disposal of the samples, as appropriate. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples shipped to any laboratory. Shipping requirements will determine how sample shipping containers are prepared for shipment. The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. Chain-of-custody procedures will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained. Each time the responsibility changes for the custody of the sample, the new and previous custodians will sign the record and note the date and time. The sampler will make a copy of the signed record before sample shipment and will transmit the copy to Project Hanford Management Contractor Sample and Data Management within 48 hours of shipping.

Except for volatile organic analyte (VOA) samples, a custody seal (i.e., evidence tape) will be affixed to the lid of each sample jar. The container seal will be inscribed with the sampler's initials and the date. Custody tape is not applied directly to VOA bottles collected because of a potential for fouling the laboratory equipment.

The radiological control technician will measure both the contamination levels on the outside of each sample jar and the dose rates. The radiological control technician also will measure the radiological activity in the sample container (through the container) and will document the highest contact radiological reading in millirem per hour. This information, along with other data, will be used to select proper packaging, marking, labeling, and shipping paperwork in accordance with U.S. Department of Transportation regulations (49 CFR, "Transportation") and to verify that the sample can be received by the analytical laboratory in accordance with the laboratory's acceptance criteria. The sampler will send copies of the shipping documentation to Project Hanford Management Contractor Sample and Data Management within 48 hours of shipping.

Samples will be shipped to a DOE-approved laboratory for analysis. Analytical requirements, sample radioactivity level, and laboratory capabilities will determine the laboratory used for sample analysis.

2.2.4 Laboratory Sample Custody

Sample custody during laboratory analysis is addressed in the applicable laboratory standard operating procedures, which will ensure the maintenance of sample integrity and identification throughout the analytical process.

2.2.5 Analytical Methods

Analytical parameters and methods are listed in Tables 2-1 and 2-2. These analytical methods are implemented in accordance with the laboratory's QA plan and the requirements of this QAPjP.

Laboratories providing analytical services in support of this SAP will be responsible for establishing a corrective-action program that addresses the following:

- Evaluation of impacts of laboratory QC failures on data quality
- Root-cause analysis of QC failures
- Evaluation of recurring conditions that are adverse to quality
- Trend analysis of quality-affecting problems
- Implementation of a quality improvement process
- Control of nonconforming materials that may affect data quality.

Implementation of these corrective-action processes will be evaluated as part of yearly laboratory audits by Hanford Site contractors or by DOE.

Communications with the laboratory will be managed by the Sample and Data Management organization. Sample and Data Management will be responsible for communicating status, issues, corrective actions, and other pertinent laboratory information to the Waste Site Remediation Task Lead and the Waste Site Remediation Manager.

2.2.6 Quality Control

The QC procedures must be followed in the field and laboratory to ensure that reliable data are obtained. When field sampling is performed, field QC procedures will be followed that prevent the cross-contamination of sampling equipment, sample bottles, and other equipment that could compromise sample integrity.

Field QC samples will be collected to evaluate the potential for cross-contamination and laboratory performance. Field QC for sampling under this SAP will require the collection of field duplicates, field splits, equipment rinsate blanks, and trip-blank samples. The QC samples and the required frequency for collection are described in this section.

The collection of QC samples for onsite measurements is not applicable to the field-screening techniques described in this SAP. Field-screening instrumentation will be calibrated and controlled as discussed in Sections 2.2.7 and 2.2.8, as applicable.

The laboratory method blanks, laboratory control sample/blank spike, and matrix spike are defined in Chapter 1 of SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update III-A*, as amended, and will be run at the frequency specified in that reference.

To ensure sample and data usability, the sampling associated with this SAP will be performed in accordance with established sampling practices, procedures and requirements pertaining to sample collection, collection equipment, and sample handling. The Field Team Lead and the Waste Site Remediation Task Lead are responsible for ensuring that all field procedures are followed completely and that field sampling personnel are adequately trained to perform sampling activities under this SAP. The Waste Site Remediation Lead, or the Field Team Lead at the discretion of the Waste Site Remediation Task Lead, must document all deviations from procedures or other problems pertaining to sample collection, chain of custody, contaminants of potential concern, sample transport, or noncompliant monitoring. As appropriate, such deviations or problems will be documented in the field logbook or in nonconformance report forms in accordance with internal corrective-action procedures. The Waste Site Remediation Lead, or the Field Team Lead at the discretion of the Waste Site Remediation Task Lead, will be responsible for communicating field corrective action requirements and for ensuring that immediate corrective actions are applied to field activities.

2.2.6.1 Field Duplicates

Field duplicates are independent samples collected as close as possible to the same point in space and time, taken from the same source, stored in separate containers, and analyzed independently. These samples are not to be homogenized together.

A minimum of one field duplicate will be collected from each waste site where soil sampling is performed. The duplicate should be collected generally from an interval that is expected to have some contamination, so that valid comparisons between the samples can be made (i.e., at least some of the COPCs will be above detection limit). When sampling is performed with a split spoon, the duplicate sample could be from a separate split spoon, either above or below the main sample, because of sample volume requirements.

2.2.6.2 Field Splits

Field splits of soil samples are not considered necessary to be collected under this SAP. However, during sampling, sample personnel could identify a need to collect a soil split sample to verify the performance of the primary laboratory. If so, the sample medium will be homogenized, split into two separate aliquots in the field, and sent to two independent laboratories. The split sample will be obtained from a sample medium suitable for analysis at an offsite laboratory and will be analyzed for all of the analytes listed in Tables 2-1 and 2-2.

2.2.6.3 Equipment Rinsate Blanks

A minimum of one field duplicate will be collected from each waste site where soil sampling is performed. The field geologist may request that additional equipment blanks be taken. Equipment blanks will consist of pure deionized water washed through decontaminated sampling equipment and placed in containers, as identified on the project Sampling Authorization Form. Note that the bottle and preservation requirements for water may differ from the requirements for soil.

Equipment rinsate blanks will be analyzed for the following:

- When characterization analysis is for radionuclides only
  - Gamma emitters
  - Gross alpha
  - Gross beta
- When characterization analysis is for radionuclides and chemical constituents
  - Gamma emitters
  - Gross alpha
  - Gross beta

- Metals (excluding hexavalent chromium and mercury)
- Anions
- Semivolatile organic analytes
- Volatile organic analytes.

2.2.6.4 Trip Blanks

The volatile organic trip blanks will constitute approximately 5 percent of all samples designated for analysis of volatile organic compounds, or approximately one in every sixth batch (cooler) that contains samples requiring volatile-organic-compound analyses. A minimum of one VOA trip blank will be collected at each waste site where the samples will undergo volatile organic compound analysis, The trip blank will consist of pure deionized water added to clean sample containers in the Sample Shipping Facility. These containers will be transported to the field with the bottle set(s) and will be returned unopened to the laboratory. The trip blank will be analyzed only for volatile organic compounds.

2.2.7 Instrument/Equipment Testing, Inspection, and Maintenance

All onsite environmental instruments will be tested, inspected, and maintained in accordance with the manufacturer's operating instructions and in accordance with approved work packages. Results from testing, inspection, and maintenance activities are documented in logbooks and/or work packages.

Analytical laboratory instruments and measuring equipment are tested, inspected, and maintained in accordance with the laboratories' QA plans. Daily response checks for radiological field survey instruments are performed in accordance with approved work packages.

Measurement and testing equipment used in the field or in the laboratory for verifying conformance to requirements, monitoring processes, or collecting data shall be controlled, calibrated to required accuracy limits, and maintained at specific intervals in accordance with the onsite organization QA plan or laboratory operating procedures (as appropriate).

2.2.8 Instrument/Equipment Calibration and Frequency

Calibration of laboratory instruments will be performed in a manner consistent with SW-846 for nonradionuclide analyses. Radionuclide analyses will be in accordance with Hanford Site procedures for onsite laboratories or with contract QA requirements for offsite commercial analytical laboratories.

All onsite environmental instruments are calibrated in accordance with the manufacturer's operating instructions, internal work requirements and processes, and/or work packages that provide direction for equipment calibration or verification of accuracy by analytical methods. Calibration is conducted with equipment or standards with known valid relationships to nationally recognized performance standards. Equipment used in this data-collection activity that requires calibration will be listed in the field work package. Such equipment is uniquely identified and calibrated in accordance with the equipment-specific calibration procedure, including the program for maintaining calibration records traceable to the uniquely identified piece of equipment. The results from all instrument calibration activities are recorded in logbooks and/or work packages.

Analytical laboratory instruments and measuring equipment are calibrated in accordance with laboratories' QA plans. Calibration of radiological field survey instruments on the Hanford Site is performed under contract by Pacific Northwest National Laboratory on an annual basis, as specified in their program documentation.

2.2.9 Inspection/Acceptance of Supplies and Consumables

Supplies and consumables procured by Fluor Hanford that are used in support of sampling and analysis activities are procured in accordance with internal work requirements and processes that describe the PHMC acquisition system. The procurement process ensures that purchased items and services comply with applicable procurement specifications, thereby ensuring that structures, systems, and components, or other items and services procured/acquired for Fluor Hanford meet the specific technical and quality requirements. Supplies and consumables are appropriately issued to the field and then checked and accepted before use.

Supplies and consumables procured by the analytical laboratories are procured, checked, and used in accordance with their QA plans.

2.2.10 Nondirect Measurements

Nondirect measurements include data obtained from sources such as computer databases, programs, literature files, and historical databases. Nondirect measurements are not planned to be used or acquired as a portion of this data acquisition activity and so will not be evaluated as part of this QAPjP.

2.2.11 Data Management

Data resulting from the implementation of this SAP will be managed and stored in accordance with applicable programmatic requirements governing data management. All analytical data packages will be subject to final technical review before the results are submitted to the regulatory agencies or included in reports. Electronic data access, when appropriate, will be via a database (e.g., HEIS or a project-specific database). Where electronic data are not available, hard copies will be provided in accordance with Section 9.6 of the Tri-Party Agreement (Ecology et al. 1989).

Planning for sample collection and analysis will be in accordance with the programmatic requirements governing fixed laboratory sample-collection activities. In the event that specific procedures do not exist for a particular work evolution, or if additional guidance is needed to complete certain tasks, a work package will be developed to adequately control the activities, as appropriate. Examples of the sample teams' requirements include the activities associated with the following:

- Chain-of-custody/sample analysis requests
- Project and sample identification for sampling services
- Control of certificates of analysis
- Logbooks, checklists
- Sample packaging and shipping.

Approved work control packages and procedures will be used to document radiological measurements when implementing this SAP. Examples of the types of documentation for field radiological data include the following:

- Instructions regarding the minimum requirements for documenting radiological controls information as per 10 CFR 835, "Occupational Radiation Protection"

- Instructions for managing the identification, creation, review, approval, storage, transfer, and retrieval of Hanford Site radiological records

- The minimum standards and practices necessary for preparing, performing, and retaining radiological-related records

- The indoctrination of personnel on the development and implementation of survey/sample plans

- The requirements associated with preparing and transporting regulated material.

Data will be cross referenced between laboratory analytical data and radiation measurements to facilitate interpreting the investigation results.

Errors are reported to the Fluor Hanford Office of Sample Management on a routine basis. Laboratory errors are reported to the Sample Management Project Coordinator, who initiates a Sample Disposition Record in accordance with PHMC procedures. This process is used to document analytical errors and to establish their resolution with the Waste Site Remediation Task Lead. The Sample Management Project Coordinator provides the Sample Disposition Record to the task lead for review and signature. The Sample Disposition Records become a permanent part of the analytical data package for future reference and for records management. In addition, the PHMC QA Engineer receives quarterly reports that provide summaries and summary statistics of the analytical errors.

2.3 ASSESSMENT / OVERSIGHT

Assessment and oversight activities evaluate the effectiveness of project implementation and associated QA and QC activities. Such assessments are conducted to ensure that SAP and QAPjP requirements are implemented as prescribed. The following sections describe possible assessment activities and reports to management if data quality issues arise during sampling, and they describe a final report at the end of the project to evaluate whether data satisfy SAP and DQO requirements.

2.3.1 Assessments and Response Action

The Project Hanford Management Contractor management, regulatory compliance, quality, and/or health and safety organizations may conduct random surveillances and assessments to verify compliance with the requirements outlined in this SAP, project work packages, the project quality management plan, procedures, and regulatory requirements. Currently, only a data quality assessment is planned for the activities identified in this SAP; this assessment is discussed in Section 2.4.3. No other planned assessments have been identified.

If circumstances should arise in the field that would dictate the need for additional assessment activities, these activities would be performed and recorded in accordance with approved procedures. Deficiencies identified by these assessments will be reported in accordance with existing programmatic requirements. The project's line management chain coordinates the corrective actions/deficiencies in accordance with the Project Hanford Management Contractor Quality Assurance Program, the Corrective Management Action Program, and associated approved procedures that implement these programs.

Oversight activities in the analytical laboratories, including corrective action management, are conducted in accordance with the laboratories' QA plans. To ensure that laboratory QA requirements are met, a program exists whereby PHMC personnel conduct intermittent oversight activities for offsite analytical laboratories in accordance with Hanford Site QA program requirements to qualify them for performing Hanford Site analytical work.

2.3.2 Reports to Management

Reports to management on data quality issues will be made if and when these issues are identified by self-assessments. These issues will be reported to the Sample Management Group, which will convey the issues to the Waste Site Remediation Task Lead, as appropriate. Subsequently, standard reporting protocols (e.g., project status reports) will be used to communicate these issues to management. Because no performance or system assessments are planned as part of this activity, the Waste Site Remediation Task Lead will not be providing audit or assessment reports to management for this activity unless an unanticipated request is made to conduct such an assessment. At the end of the project, a data quality assessment report (Section 2.4.3) will be prepared to evaluate whether the type, quality, and quantity of data that were collected to satisfy the DQO and SAP requirements.

2.4 DATA VALIDATION AND USABILITY

Data validation and usability activities occur after the data-collection phase of the project is completed. Implementation of these elements determines whether or not the data conform to the specified criteria, thus satisfying the project objectives.

2.4.1 Data Review, Verification, and Validation

Data will be reviewed, and data verification and validation will be performed on analytical data sets. These activities confirm that sampling and chain-of-custody documentation is complete and sample numbers can be tied to the specific sampling location described in Section 2.2.3, that samples were analyzed within required holding times identified in Table 2-4, and that sample analyses met the data quality requirements specified in the FSP (Chapter 3.0).

2.4.2 Verification and Validation Methods

Completed data packages will be validated by qualified Fluor Hanford Sample and Data Management personnel or by an independent contractor qualified in accordance with Hanford Site QA program requirements. Verification will consist of verifying required deliverables, requested versus reported analyses, and transcription errors. Validation will include evaluating and qualifying the results, based on holding times, method blanks, laboratory control samples, laboratory duplicates, and chemical and tracer recoveries, as appropriate. No other validation or calculation checks will be performed.

Validation requirements identified in this section are consistent with Level C validation, as defined in data-validation procedures. Level C data validation is consistent with the data validation levels for the original RI work plans. Level C data validation, as defined in the contractor's validation procedures, which are based on EPA functional guidelines (Bleyler, 1988a, *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses*; Bleyler, 1988b, *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses*), will be performed for up to 5 percent of the data by matrix and analyte group. The goal is to cover the various analyte groups and matrices during the validation. When outliers or illogical results are identified in the data quality assessment, additional data validation will be performed. The additional validation will be up to 5 percent of the statistical outliers and/or illogical data. The additional validation will begin with Level C and may increase to Levels D and E as needed to ensure that the data are usable. Note that Level C validation is a review of the QC data, while Levels D and E include review of calibration data and calculations of representative samples from the dataset. All data validation will be documented in data validation reports. With the exception of "R" qualified or rejected data, all data will be used.

At least one data validation package will be generated per sampled waste site. Level C validation is consistent with the data-validation requirements identified in the respective RI/FS process work plan. Relative to analytical data, physical data and/or field-screening results are of lesser importance in making inferences of risk. Because of the secondary importance of such data, no validation for physical property data and/or field-screening results will be performed. However, field QA/QC will be reviewed to ensure that the data are useable. Field instrumentation, calibration, and QA checks will be performed in accordance with the following.

- Calibration of radiological field instruments on the Hanford Site is performed under contract by Pacific Northwest National Laboratory, as specified in their program documentation.

- Daily calibration checks will be performed and documented for each instrument used to characterize areas that are under investigation. These checks will be made on standard materials that are sufficiently like the matrix under consideration that direct comparison of data can be made. Analysis times will be sufficient to establish detection efficiency and resolution.

The approval of field-data-collection plans by the Radiological Engineering Manager represents the data validation and usability review for handheld field radiological measurements.

2.4.3 Reconciliation with User Requirements

A data quality assessment will be performed on the resulting analytical data in accordance with EPA/240/B-06/002, *Data Quality Assessment: A Reviewers Guide*, EPA QA/G-9R. The data quality assessment process compares completed field sampling activities to those proposed in corresponding sampling documents and provides an evaluation of the resulting data. The purpose of the data evaluation is to determine whether quantitative data are of the correct type and are of adequate quality and quantity to meet the project DQOs. The EPA data quality assessment process (EPA/240/B-06/002 and EPA/240/B-06/003, *Data Quality Assessment, Statistical Tools for Practitioners*, EPA QA/G-9S) identifies five steps for evaluating data generated from this project, as summarized below.

Step 1. Review DQOs and Sampling Design. This step requires a comprehensive review of the sampling and analytical requirements outlined in the project-specific DQO workbook and SAP.

Step 2. Conduct a Preliminary Data Review. In this step, a comparison is made between the actual QA/QC achieved (e.g., detection limits, precision, accuracy) and the requirements determined during the DQO. Any significant deviations will be documented. Basic statistics will be calculated from the analytical data at this point, as appropriate to the data set, including an evaluation of the distribution of the data and in accordance with the DQOs.

Step 3. Select the Statistical Test. Using the data evaluated in Step 2, an appropriate statistical hypothesis test is selected and justified.

Step 4. Verify the Assumptions. In this step, the validity of the data analyses is assessed by determining if the data support the underlying assumptions necessary for the analyses or if the data set must be modified (e.g., transposed, augmented with additional data) before further analysis. If one or more assumptions are questioned, Step 3 is repeated.

Step 5. Draw Conclusions from the Data. The statistical test is applied in this step, and the results either reject the null hypothesis or fail to reject the null hypothesis. If the latter is true, the data should be analyzed further. If the null hypothesis is rejected, the overall performance of the sampling design should be evaluated by forming a statistical power calculation to assess the adequacy of the sampling design.

Table 2-1. Analytical Performance Requirements for Radionuclides – Shallow- and Deep-Zone Soils.

Contaminants of Potential Concern	Chemical Abstracts Service #	Preliminary Action Level [a]				Name/Analytical Technology	Required Target Quantitation Limits, Soil (pCi/g)	Precision [d] (%)	Accuracy [d] (%)
		Human Health (15 mrem/yr [b])		Ground-water Protection [c] (pCi/g)	Ecological Protection (pCi/g)				
		Industrial (pCi/g)	Unres-tricted (pCi/g)						
Americium-241	14596-10-2	335	31.0	N/A	3,890	Americium isotopic – AEA	1	±30	70-130
Cesium-137	10045-97-3	23.4	6.2	N/A	20.8	GEA	0.1	±30	70-130
Europium-154	15585-10-1	10.3	3.0	N/A	1,290	GEA	0.1	±30	70-130
Neptunium-237	13994-20-2	59.2	2.44	N/A	1,900	Np-237 – AEA	1	±30	70-130
Plutonium-239/240	Pu-239/240	425	33.9	N/A	6,110	Plutonium isotopic – AEA	1	±30	70-130
Strontium-90	Rad-Sr	2,410	3.8	N/A	22.5	Total radioactive strontium – GPC	1	±30	70-130
Technetium-99	14133-76-7	412,000	8.5	TBD	4,490	Tc-99 – liquid scintillation	15	±30	70-130
Uranium-238	U-238	504	90.0 or 0.61	TBD	1,580	Uranium isotopic – AEA (pCi) ICP/MS (mg)	1	±30	70-130

[a] The preliminary action level (from the data quality objectives process) is the regulatory or risk-based value used to determine appropriate analytical requirements (e.g., detection limits). Remedial-action levels will be proposed in the feasibility study, will be finalized in the record of decision, and will drive remediation of the waste sites.

[b] 15 mrem/yr = nonradiological worker industrial exposure scenario; 2,000 h/yr onsite, 60% indoors, 40% outdoors.. Industrial land-use values generally apply to locations within the industrial exclusive area (Core Zone) and are dependent on the nature and extent of contamination. Unrestricted land-use values that could be applied at some sites outside the industrial-exclusive land-use area are shown.

[c] Groundwater protection radionuclide values are based on either RESRAD (ANL, 2002, *RESRAD for Windows*, Version 6.21, or STOMP (PNNL-12028, *STOMP Subsurface Transport Over Multiple Phases, Version 2.0, Application Guide*) modeling of drinking water exposure, with the entire vadose zone presumed to be contaminated.

[d] Precision and accuracy requirements as identified and defined in the referenced U.S. Environmental Protection Agency procedures implemented by laboratory analysis and quality assurance procedures.

AEA = alpha energy analysis.
GEA = gamma energy analysis.
GPC = gas proportional counting.
ICP/MS = inductively coupled plasma/mass spectrometry.
N/A = not applicable.
TBD = to be determined.

Table 2-2. Analytical Performance Requirements for Nonradionuclides – Shallow- and Deep-Zone Soils. (2 Pages)

Contaminants of Potential Concern	Chemical Abstracts Service #	Preliminary Action Level [a]: Direct Contact, WAC 173-340 [b] (mg/kg): Method C Industrial	Preliminary Action Level [a]: Direct Contact, WAC 173-340 [b] (mg/kg): Method B Unrestricted	Preliminary Action Level [a]: Groundwater Protection [c] (mg/kg)	Preliminary Action Level [a]: Terrestrial Biota Protection [d] (mg/kg)	Name/Analytical Technology [f]	Required Target Quantitation Limits, Soil-Other, Low Concentration (mg/kg)	Precision Soil (%) [e]	Accuracy Soil (%) [e]
Metals									
Antimony	7440-36-0	1,400	32.0	5.4	5	Metals – 6010 – ICP	5	±30	70-130
Cadmium	7440-43-9	3,500	80.0	0.81 (Background)	4	Metals – 6010 – ICP (trace) or EPA Method 200.8	0.5	±30	70-130
Copper	7440-50-8	130,000	29,600	263	50	Metals – 6010 – ICP or EPA Method 200.8	2.5	±30	70-130
Lead	7439-92-1	1,000 [g]	250 [g]	270	50	Metals – 6010 – ICP (trace) or EPA Method 200.8	1	±30	70-130
Manganese	7439-96-5	490,000	11,200	65.3	1100	Metals – 6010 – ICP or EPA Method 200.8	5	±30	70-130
Mercury	7439-97-6	1,050	24.0	2.09	0.30	Mercury – 7470 – CVAA or EPA Method 200.8	N/A	±30	70-130
						Mercury – 7471 – CVAA or EPA Method 200.8	0.2	±30	70-130
Selenium	7782-49-2	17,500	400	5.2	TBD	Metals – 6010 – ICP	1	±30	70-130
Silver	7440-22-4	17,500	400	13.6	2	Metals – 6010 – ICP (trace) or EPA Method 200.8	0.5	±30	70-130
Thallium	7440-28-0	245	5.6	1.59	1.0	Metals – 6010 – ICP or EPA Method 200.8	0.5	±30	70-130
Uranium (total)	7440-61-1	10,500	240	1.32	5	Uranium total – kinetic phosphorescence analysis	1	±30	70-130

Table 2-2. Analytical Performance Requirements for Nonradionuclides – Shallow- and Deep-Zone Soils. (2 Pages)

Contaminants of Potential Concern	Chemical Abstracts Service #	Preliminary Action Level [a]				Name/Analytical Technology [f]	Required Target Quantitation Limits, Soil-Other, Low Concentration (mg/kg)	Precision Soil (%) [e]	Accuracy Soil (%) [e]
		Direct Contact, WAC 173-340 [b] (mg/kg)		Groundwater Protection [c] (mg/kg)	Terrestrial Biota Protection [d] (mg/kg)				
		Method C Industrial	Method B Unrestricted						
Inorganics									
Cyanide	57-12-5	70,000	1600	0.80	N/A	Total cyanide – 9010 – colorimetric	0.5	±30	70-130
Fluoride	16984-48-8	210,000	4800	16	N/A	Anions – 300.0 – IC	5	±30	70-130
Nitrate	14797-55-8	Unlimited	128,000	40	N/A	Anions – 300.0 – IC	2.5	±30	70-130
Organics									
Toluene	108-88-3	70,000	16,000	11.6	200	Volatile organics – 5035/8260 – GC/MS	0.005	±30	70-130

[a] The preliminary action level (from the data quality objectives process) is the regulatory or risk-based value used to determine appropriate analytical requirements (e.g., detection limits). Remedial-action levels will be proposed in the feasibility study, will be finalized in the record of decision, and will drive remediation of the waste sites.

[b] Method C industrial is WAC 173-340-745(5), "Soil Cleanup Standards for Industrial Properties," "Method C Industrial Soil Cleanup Levels,") and Method B residential is WAC 173-340-740(3), "Unrestricted Land Use Soil Cleanup Standards," "Method B Soil Cleanup Levels for Unrestricted Land Use," values from Ecology 94-145, *Cleanup Levels and Risk Calculations under the Model Toxics Control Act Cleanup Regulation; CLARC, Version 3.1*, tables, updated November 2001.

[c] Calculated using WAC 173-340, "Model Toxics Control Act -- Cleanup," three-phase model for soil concentrations protective of groundwater per WAC 173-340-747(4), "Deriving Soil Concentrations for Ground Water Protection," "Fixed Parameter Three-Phase Partitioning Model."

[d] Value is the lowest concentration for each analyte (adjusted for background) from Tables 749-2 and 749-3 of WAC 173-340-900, "Tables," amended February 12, 2001.

[e] Precision and accuracy requirements as defined in EPA procedures and implemented by laboratory analysis and quality assurance procedures. Precision criteria for batch laboratory replicate sample analyses. Accuracy criteria for associate batch laboratory control sample percent with additional evaluations also performed for matrix spikes, tracers, and carriers as appropriate to the method.

[f] All four-digit numbers are found in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods* (SW-846). EPA Method 200.8 is found in EPA/600/4-91/010, *Methods for the Determination of Metals in Environmental Samples*.

[g] Based on WAC 173-340 Method A values from Tables 740-1 and 745-1 of WAC 173-340-900.

CVAA = cold vapor atomic absorption.
GC/MS = gas chromatography/mass spectrometry.
IC = ion chromatography.
ICP = inductively coupled plasma.
N/A = not applicable.
TBD = to be determined.

Table 2-3. Analytical Performance Requirements for Gamma Logging.

Measurement Type	Emission Type	Method/Instrument	Detection Limit
Gross-gamma logging	Gamma emissions from Cs-137 [a]	Bismuth-germanium detector	1 pCi/g [b]

[a] In the absence of the high gamma emitter Cs-137, lower gamma emitters such as Pu-239 or Am-241 could be identified.
[b] Detection limit for Am-241 and Pu-239~25 is 25 nCi/g.

Table 2-4. Sample Preservation, Container, and Holding-Time Guidelines. (2 Pages)

Analytes*	Matrix	Bottle		Amount [a,b,c]	Preservation	Packing Requirements	Holding Time [e]
		Number	Type				
Radionuclides							
Americium-241	Soil	1	G/P	10-1000 g	None	None	6 months [f]
Cesium-137	Soil	1	G/P	100-1500 g	None	None	6 months [f]
Europium-154	Soil						
Neptunium-237	Soil	1	G/P	10g	None	None	6 months [f]
Plutonium-239/240	Soil	1	G/P	10-1000 g	None	None	6 months [f]
Strontium-90							
Technetium-99							
Uranium-238							
Chemicals							
IC anions – EPA Method 300.0	Soil	1	G/P	50-500 g	Cool 4°C	Cool 4°C	28 days/ 48 hours [d]
ICP metals – 6010A	Soil	1	G/P	10-500 g	Cool 4°C	Cool 4°C	6 months
Mercury – 7471 – (CVAA)	Soil	1	G	5-125 g	Cool 4°C+/-2°C	Cool 4°C	28 days
Total cyanide – 9010	Soil	1	G	10-1000 g	Cool 4°C	Cool 4°C	14 days
SVOA – 8270A	Soil	1	AG	125-1000 g	Cool 4°C	Cool 4°C	14/40 days [e]
VOA – 5035/8260	Soil	1	AG	5 g	Freeze -7 °C to -20 °C	Freeze -7 °C to -20 °C	14 days

* 4-digit EPA Methods are found in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update III-A*, as amended. EPA Method 300.0 is found in EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples*.

[a] Optimal volumes, which may be adjusted downward to accommodate the possibility of retrieval of a small amount of sample. Minimum sample size will be defined on the Sampling Authorization Form.

[b] Should samples be liquid rather than soils, the following volumes need to be collected:
Radionuclides – 4 L for all radionuclides (except C-14, tritium, and Tc-99; they require approximately 500 mL for each sample).
Chemicals – All liquid samples require the amount listed for soil samples. Preservation and holding times also are affected if liquid samples are collected. Consult Sample Management staff for details.

[c] Mixed soil samples may be obtained and submitted to the analytical laboratory for analyses for specific analytes, including the following:
Radionuclides – 100 g of soil for all radionuclides (except C-14, tritium, and Tc-99; they require approximately 10 g for each sample).
Chemicals – A 10 g soil sample is required for all ICP analysis, 10 g soil sample is required for IC anion analysis, 5 g soil sample for hexavalent chromium analysis, , 10 g soil sample for 8015 analysis, and 125 g soil samples for each 8270 and total organic carbon analyses.

[d] The EPA Method 300.0 nitrate, nitrite, and phosphate holding time is 48 hours after sample extraction preparation. The holding time of 28 days applies to all other anions quantified by EPA Method 300.0.

[e] The first number shown is the number of days to extract and the second number is the number of days to analyze the extract.

[f] No regulatory or contractual holding time requirement exists for radiological constituent samples, and a 6-month holding time is retained as a best-management practice to prevent sample degradation.

Table 2-4. Sample Preservation, Container, and Holding-Time Guidelines. (2 Pages)

Analytes*	Matrix	Bottle		Amount [a,b,c]	Preservation	Packing Requirements	Holding Time [e]
		Number	Type				

aG = amber glass.
CVAA = cold vapor atomic absorption.
EPA = U.S. Environmental Protection Agency.
G = glass.
IC = ion chromatography.
ICP = inductively coupled plasma.
P = plastic.
SVOA = semivolatile organic analysis.
VOA = volatile organic analysis.

3.0 FIELD SAMPLING PLAN

This FSP describes the data-collection objectives; field screening and soil sampling locations and frequency; and sample management.

3.1 SAMPLING OBJECTIVES

Through the DQO process (Section 1.7 and Appendix A), the Tri-Parties agreed that additional data collection is required at the 216-A-25 Pond, 216-B-3 Pond, 216-S-16 Pond, 216-S-17 Pond (and associated UPR-200-W-124), 216-T-4B Pond, 216-U-10 Pond, and 216-U-11 Ditch. This FSP identifies and describes data-collection activities to be performed at these waste sites.

Based on the preliminary conceptual site model, the majority of the contamination is expected to be present in an organic mat that coincides with pond sediment. Because all of these waste sites have been stabilized with cover soils (Table 1-1), intrusive techniques must be employed to collect data and sample material for laboratory analysis to better understand the nature and extent of contamination at the waste sites. A multistep data-collection approach has been developed that generally begins with observational techniques such as geophysical logging, and in some cases is followed up with focused soil sampling. These characterization elements are discussed in the following text and in Table 3-1.

3.1.1 Geophysical Logging of Direct Pushes and/or Boreholes

Direct-push probes (e.g., GeoProbes[1]) will be installed, at generally predetermined locations. Push probes will be driven to a depth of approximately 4.6 m (15 ft) to 6.1 m (20 ft) below ground surface (bgs). Gross-gamma detectors will be lowered the full depth of the probes, retrieved, and then moved to the next probe, until all of the probes have been logged. The spectral-gamma logs will be used to supplement the laboratory radionuclide data to determine the vertical distribution of radionuclides in the vadose zone beneath the units and to provide correlation with other data collected from the pushes and/or borehole. The downhole tools and cable will be wiped between use at each push hole. The reference point for logging is the ground surface or the top of the probe. That information will be recorded.

A gross-gamma logging system will be used to determine the distribution and gross concentrations of Cs-137 via gamma emissions. The probes will be logged using small-diameter spectral-gamma instruments capable of detecting Cs-137 concentrations to 1 pCi/g. Geophysical logging will be continuous and thus will include the pond sediment layer as a critical data-collection point, because the highest radiological material activities are expected at this horizon. The results will be used to identify locations for subsequent soil sampling and laboratory analysis described later in this SAP.

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[1] GeoProbe is a registered trademark of GeoProbe Systems, Salina, Kansas.

The spectral-gamma logs will be used to supplement the laboratory radionuclide data to determine the vertical distribution of radionuclides in the vadose zone beneath the units, to aid in geological interpretation of subsurface stratigraphy, and to provide correlation with other data collected from the borehole. High-resolution spectral-gamma log data are processed in accordance with approved procedures. The action level for logging results is conservatively set at 24 pCi/g, equating to approximately 4 times the unrestricted land-use action level for Cs-137 of 6.4 pCi/g, which provides a 15 mrem/yr dose (Table 1-4). Direct-push probes (and/or boreholes) will be installed, geophysically logged for gamma-emitting radionuclides, and may be sampled if needed Cs-137 is the indicator parameter for focused sampling.

The spectral-gamma logging system uses standard laboratory high-purity germanium detector instrumentation to identify and quantify gamma-emitting radionuclides in boreholes as a function of depth. The high-purity germanium detector is calibrated to National Institute of Standards and Technology requirements and includes corrections for environmental conditions that deviate from the standard calibration condition. Each logging system is calibrated annually, and daily pre-run and post run verification measurements are made to ensure that system performance is within acceptable limits. The spectral-gamma logging equipment calibration is conducted annually, and the data acquired during the calibrations are used to derive factors that convert measured peak-area count rate to radionuclide concentrations in picocuries per gram. For each measurement, natural and manmade radionuclides are identified from characteristic gamma emissions, and the concentration, uncertainty (counting error), and minimum detectable level are independently calculated from gamma-energy spectra. The detector requires constant cooling with liquid nitrogen and was designed to operate completely submerged in water. Venting of the nitrogen gas to the surface is accomplished with a specially designed logging cable.

The neutron-moisture logging system that measures moisture employs a weak americium-beryllium neutron source and neutron detector to provide a direct reading of hydrogen atom distribution in the soil surrounding the borehole. This detector will be used to measure continuous vertical moisture in the vadose zone.

The drive-casing hole planned through this SAP at the 216-U-10 Pond will be logged through the casing before casing sizes are changed and at the total depth of the borehole. The downhole tools and cable will be subject to the same rules that the drill rig and equipment are subject to. The downhole tools and cable will be decontaminated and surveyed between boreholes. Corrections are applied to the data to compensate for the gamma-ray attenuation by the casing. The site geologist will record the types of geophysical surveys and the depth intervals of initial and repeat runs in the Well Construction Summary Report form.

The S. M. Stoller Corporation[2], DOE's Hanford Site geophysical logging contractor, has a new downhole geophysical logging tool that may be capable of identifying nitrate in the subsurface. If the system is available for use on the Hanford Site and the well-bore conditions are appropriate, the borehole will be logged with this tool as a means of testing this potential technique for future use. If not appropriate or available, this tool can be tested at other Hanford Site locations. This is an opportunistic application and not a requirement of this SAP.

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[2] Stoller is a trademark of S. M. Stoller Corporation, Lafayette, Colorado.

3.1.2 Direct-Push Soil Sampling and Analysis

Nonradiological and radiological soil samples will be collected from direct-push probe locations for laboratory analysis. Sample collection will follow the plans identified in Table 3-1. Sample depth intervals will be selected to correspond with the highest Cs-137 activity, based on gross-gamma logging results that exceed the Cs-137 logging action level. The Cs-137 action level that will trigger sampling will be four times the unrestricted use level of 6.4 pCi/g, representing the concentration of Cs-137 that would decay to below a 15 mrem/yr dose rate within 50 years.

Sampling will be performed using a split-spoon sampler. With the exception of the volatile organic analyte samples, soil will be transferred to a precleaned, stainless-steel mixing bowl, homogenized, and then containerized in accordance with contractor sampling procedures. Samples will be analyzed for COPCs identified in Tables 2-1 and 2-2. Quality control samples will be collected in accordance with the QAPjP. Samples collected for analysis of volatile organic compounds will be transferred directly from the split-spoon sampler to the sampling container. Physical property analyses are not planned for these shallow drive-point samples.

Additional probes will be collocated to obtain sufficient sample volume if needed. Other field-screening techniques, such as hand-held radiation detectors, can be used in conjunction with the above guidance to determine actual sample depths. Samples also may be collected and analyzed at the discretion of the Waste Site Remediation Task Lead and Field Team Leader (Section 2.1.1), based on field conditions, measurements, or observations.

3.1.3 Borehole Drilling and Sampling and Analysis

A single borehole is planned at the 216-U-10 Pond as a portion of the Model Group 5 supplemental data-collection activity to be drilled in the 216-U-10 Pond as shown in Figure 3-6. Drilling and sampling for this vadose-zone investigation will stop at approximately 42.7 m (140 ft) bgs. Physical property samples are not planned. All drilling will be via a method approved by the project and will conform to site-specific technical specifications for environmental drilling services. Drilling generally is done with a cable tool rig or a similar type rig. This allows control of contaminated cuttings, permits spectral-gamma and other types of downhole geophysical logging, and provides adequate soil return to support soil sampling, either through a split spoon sampler or through a grab sample. Actual conditions during drilling may warrant changes to standard drilling and casing installation practices after approval is obtained from the Waste Site Remediation Task Lead. The 216-U-10 Pond borehole will not be used as a monitoring well, and after the soil investigation, the casing will be removed and the borehole will be decommissioned in accordance with WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells."

The intent of the sampling design at the 216-U-10 Pond is to begin sample collection at the depth corresponding to the crib bottom and continue sampling intermittently (based on the site's conceptual contaminant distribution model, results of borehole logging, and professional judgment of the field geologist) to a depth of approximately 42.7 m (140 ft) bgs. The sediment layer near the bottom of the pond is expected to have the highest potential for contamination associated with low-mobility contaminants.

The borehole soil sampling associated with this SAP will be performed in accordance with established sampling practices and requirements pertaining to sample collection, collection equipment, and sample handling. Samples will be collected for the focused list of COPCs identified in Table 3-1 to fulfill specific supplemental data needs identified during the DQO. Borehole soil samples will be collected and managed as described in Table 2-4. Samples will undergo laboratory analysis for radiological and nonradiological COPCs identified in Table 3-1 in accordance with analytical requirements in Tables 2-1 and 2-2. Samples will be analyzed at an onsite laboratory. Physical property samples, generally collected from boreholes to provide site-specific values to support the RESidual RADioactivity (RESRAD) dose model (ANL, 2002, *RESRAD for Windows*, Version 6.21), are not required for this focused sampling activity.

Soil samples generally are collected from the borehole using a split-spoon sampler. equipped with up to four separate stainless-steel liners. Site personnel will not overdrive the sampling device. With the exception of volatile organic analyte samples, soil will be transferred to a pre-cleaned, stainless-steel mixing bowl, homogenized, and then containerized in accordance with contractor sampling procedures. Cuttings and split-spoon samples could be field screened for radioactivity and/or organic contaminants, although organic vapors are not a concern in the vadose-zone soils of the pond waste sites.

Problems with sample collection, custody, or data acquisition that adversely impact the quality of data or that impair the ability to acquire data, or failure to follow procedure, will be documented in accordance with internal corrective action procedures, as appropriate. Soil sample preservation, containers, and holding times for chemical and radiological analytes of interest are presented in Table 2-4. Final sample collection requirements will be identified on the Sampling Authorization Form.

3.1.4 Test-Pit Excavation and Sampling and Analysis

Test pits will be excavated to obtain sample material at the 216-U-10 Pond (Section 3.2). Test pits are shallow excavations into the vadose zone to view soil materials and collect samples. The test pits will be excavated with an excavator and only need to be large enough to obtain the samples at the pond bottom or to range to a maximum target depth of 7.6 m (25 ft). Site-specific test-pit locations may be adjusted in the field to account for site conditions. If basalt is encountered in the test pits, excavations will be halted.

Test pits will be excavated in a manner that minimizes the generation of visible emissions (e.g., dust) from the site boundary during backhoe operations by use of water or a fixant sprayed on the site before and during the activity. If visible emissions cannot be controlled, the activity will be postponed. When the slope of the sides is too steep for the safe use of heavy excavation equipment, a shallow test pit can be accessed using hand augers and shovels. Although not planned, a hollow-stem auger may be used as an alternative if it is determined to be more cost-effective. Samples collected from hollow-stem augers will require the use of a large-diameter split-spoon sampler that usually necessitates compositing the sample through at least 0.3 to 0.6 m (1 to 2 ft) to get adequate sample sizes for analysis.

Test-pit soil sampling associated with this SAP will be performed in accordance with established sampling practices and requirements pertaining to sample collection, collection equipment, and sample handling. Samples will be collected for the focused list of COPCs identified in Table 3-1 to fulfill specific supplemental data needs identified during the DQO. Test-pit soil samples will be collected and managed as described in Table 2-4. Samples will undergo laboratory analysis for radiological and nonradiological COPCs identified in Table 3-1 in accordance with analytical requirements in Tables 2-1 and 2-2. Samples will be analyzed at an onsite laboratory. Physical property samples are not required for this focused sampling activity.

Samples from a test pit generally will be collected from the waste site sediment layer (e.g., pond bottom/organic mat) as identified through radiological field screening, visual observation, and judgment of the geologist/sampler or at the first detection of contamination (generally above background), whichever is encountered first. Where ALARA considerations allow, samples should be taken directly from the test-pit strata. Alternatively, samples will be collected directly from the backhoe bucket that will target the interval 0.3 m (1 ft) below the specified sample depth to help ensure that the sample target depth material is accessible in the bucket. Volatile samples, where necessary, will be collected first, directly from the excavator bucket into appropriate sample containers, to minimize loss to the atmosphere. For the remainder of the analytes, sample material will be scooped from the bucket into a precleaned, stainless-steel mixing bowl, homogenized, and then containerized in accordance with contractor sampling procedures. Samples will be collected from non-wetted soils, whenever possible, when fixant/water is used for dust control. Additional samples may be collected at the discretion of the geologist/sampler based on field screening information, to further verify the location of the pond bottom, depending on the limits of the excavation equipment.

3.2 SITE-SPECIFIC CHARACTERIZATION

For each Model Group 5 site identified in Table 1-2 as requiring supplemental data, the site-specific data-collection activities and the rationale for data collection are identified in Table 3-1.

3.2.1 Preshipment Sample Screening

A representative portion of each sample to be shipped to an offsite laboratory will be submitted to the Radiological Counting Facility, 222-S Laboratory, or other suitable onsite laboratory for total activity analysis before it is shipped. Total activities will be used for sample preshipment characterization. Samples that slightly exceed the offsite laboratory criteria discussed in Section 2.2.3 may be reduced in volume to allow offsite shipment. Onsite and offsite laboratories will be identified before field activities are initiated and will be mutually acceptable to the Sample and Data Management group and to the Waste Site Remediation Task Lead.

3.2.2 Summary of Sampling Activities

The number and types of samples to be collected are summarized in Table 3-2.

3.2.3 Potential Sample Design Limitations

The sample design developed for this SAP has potential limitations that may affect the data-collection results. Some of the factors that have the potential to affect the outcome of this sampling include the following.

1. The geophysical logging locations were based on the assumption that the COPCs preferentially would be deposited where the wastewater velocities decreased, although deposition could be influenced by other factors. Historical data for the pond waste sites may show significant spatial variability.

2. Drilling impediments (e.g., boulders) may be encountered.

3. Insufficient sample volumes may be retrieved from planned small-diameter direct-push probes.

3.2.3.1 Sampling Contingencies

Possible contingency considerations offset the potential limitations encountered during sampling in the ponds. The Waste Site Remediation Task Lead will evaluate the need to implement contingent actions on a case-by-case basis.

The Waste Site Remediation Task Lead is responsible for direct management of sampling documents and requirements and field activities in accordance with Section 2.1.1.2 and will be responsible for deciding alternative field sample locations if drilling impediments are encountered.

If sample volume requirements cannot be met because of poor recovery from a direct-push probe, the Waste Site Remediation Task Lead will identify the location of additional direct-push probe(s) to be installed to collect more sample material.

3.2.3.2 Soil Screening

All soil samples and cuttings from the direct pushes and the borehole will be field screened for evidence of radioactive contamination by the radiological control technician. Surveys of these materials will be conducted with field instruments. The radiological control technician will record all field measurements for entry into the field logbook, noting the depth of the sample and the instrument reading.

Before excavation, a local area background reading will be taken with the field-screening instruments at a background site to be selected in the field. Field screening of drill cuttings and visual observations of the soil (e.g., sediment/clay layer, organic debris) will be used to optimize sample selection, assist in determining sample shipping requirements, and support worker health and safety monitoring. The field geologist will use gross-gamma logging results, professional judgment, screening data, and the information provided in this FSP to finalize sampling decisions. Gross-gamma logging methods, instruments, and detection limits are identified in Table 2-3.

Samples exceeding 0.5 mrem/h may be stored at a temporary onsite radioactive material storage area until they are shipped to the laboratory. If soil samples contain significant concentrations of radiological constituents, they may be analyzed in an onsite laboratory.

Field-screening instruments will be used, maintained, and calibrated in accordance with the manufacturer's specifications and other approved procedures. The field geologist will record field-screening results in the log.

Figure 3-1. Location of Planned Data Collection at the 216-A-25 Pond.

See Table 3-1 for sample details.

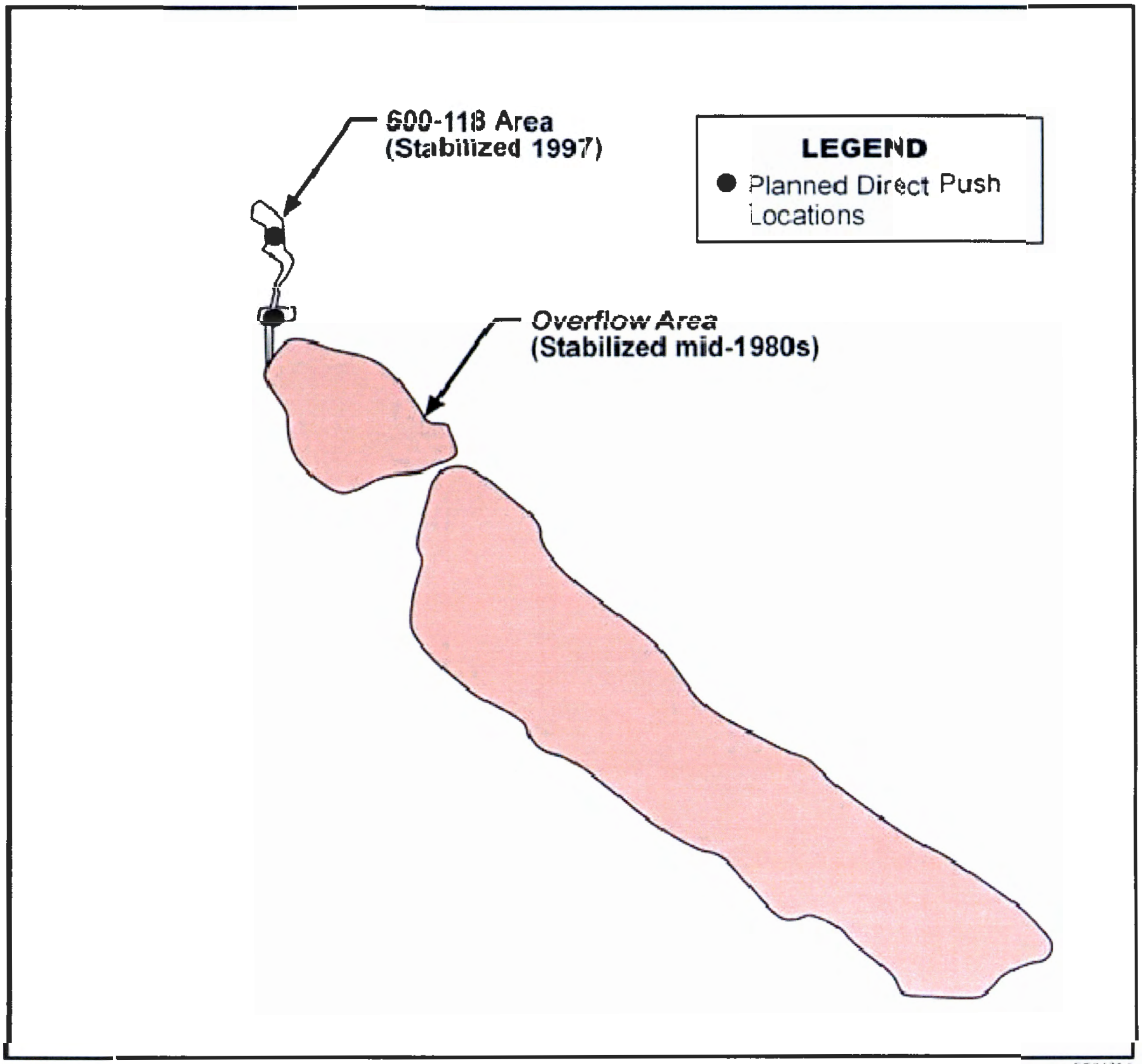

Figure 3-2. Location of Planned Data Collection at the 216-B-3 Ponds.

See Table 3-1 for sample details.

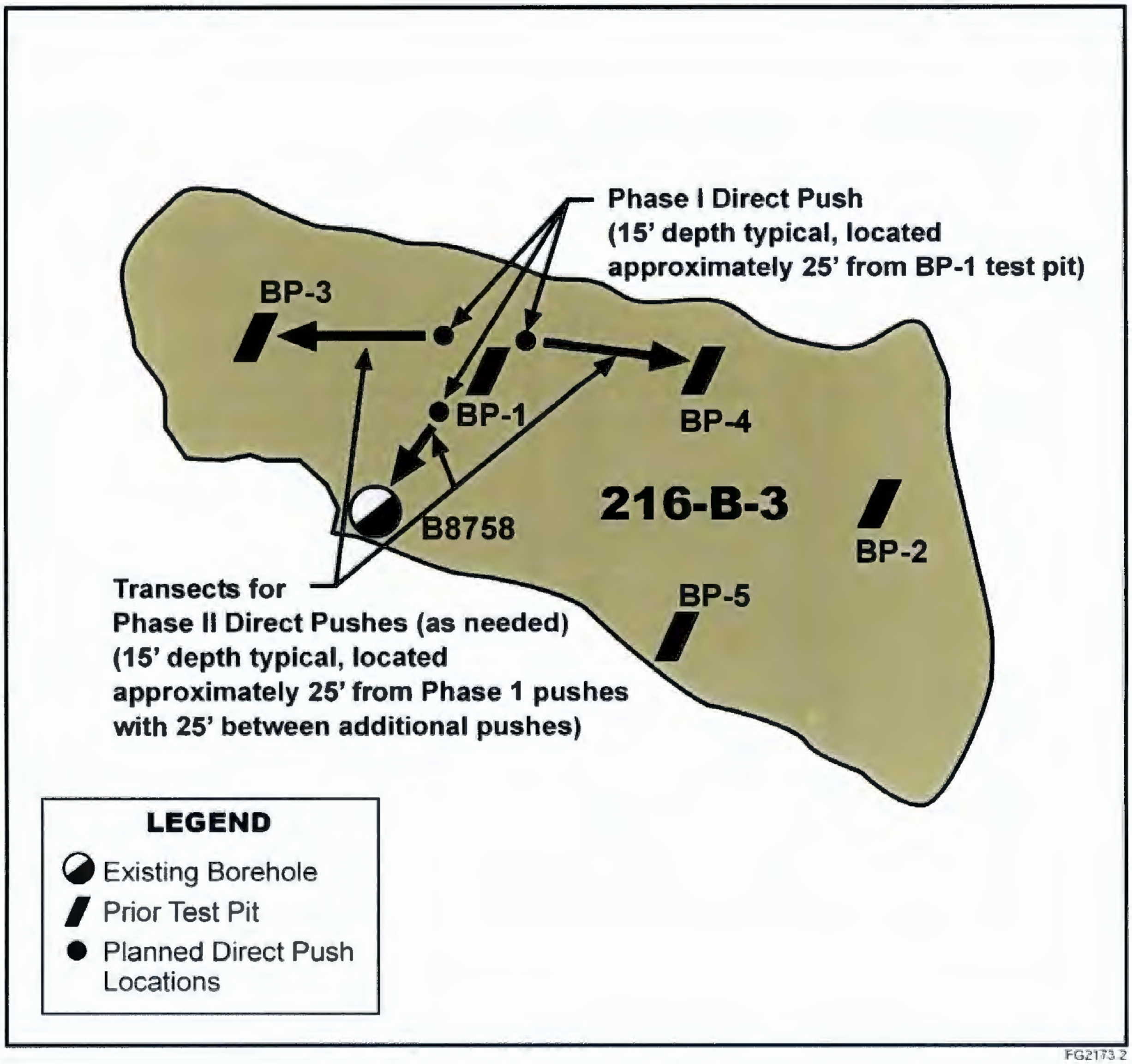

Figure 3-3. Planned Geophysical Logging Locations at the 216-S-16 Pond.

See Table 3-1 for sample details.

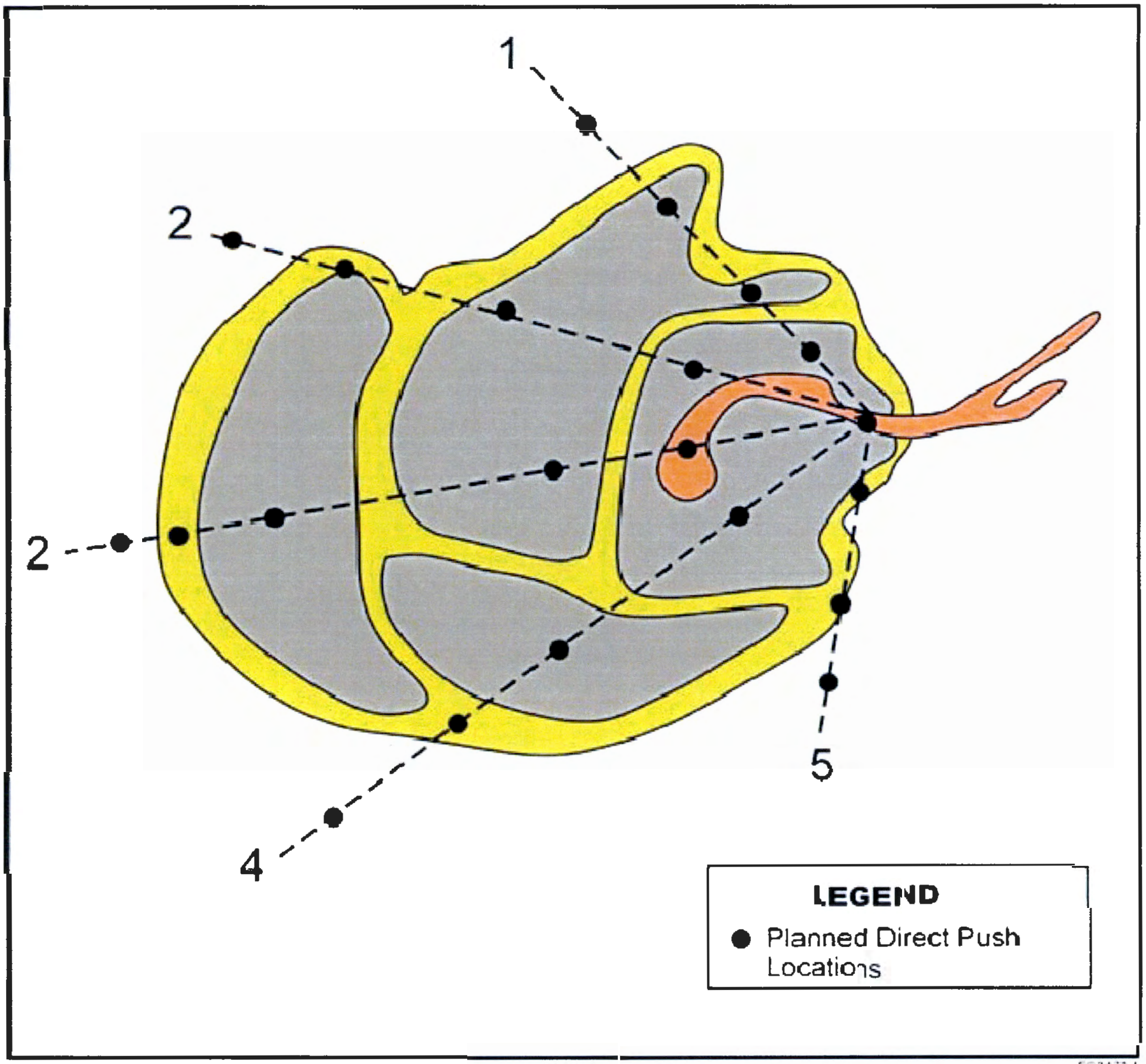

Figure 3-4. 216-S-17 Pond Logging and Soil Sample Locations.

See Table 3-1 for sample details.

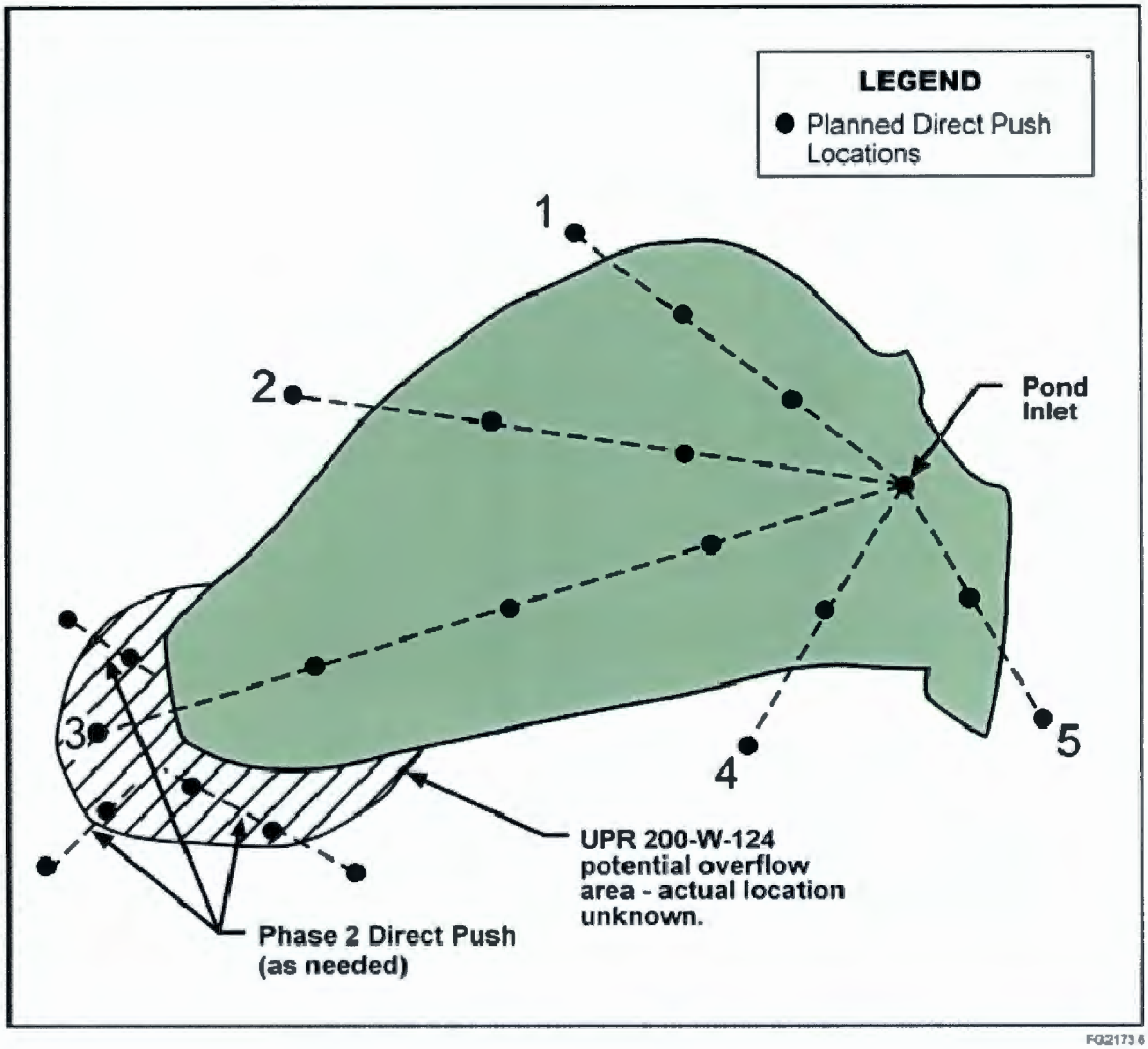

Figure 3-5. 216-T-4B Pond Data Collection Locations.

See Table 3-1 for sample details.

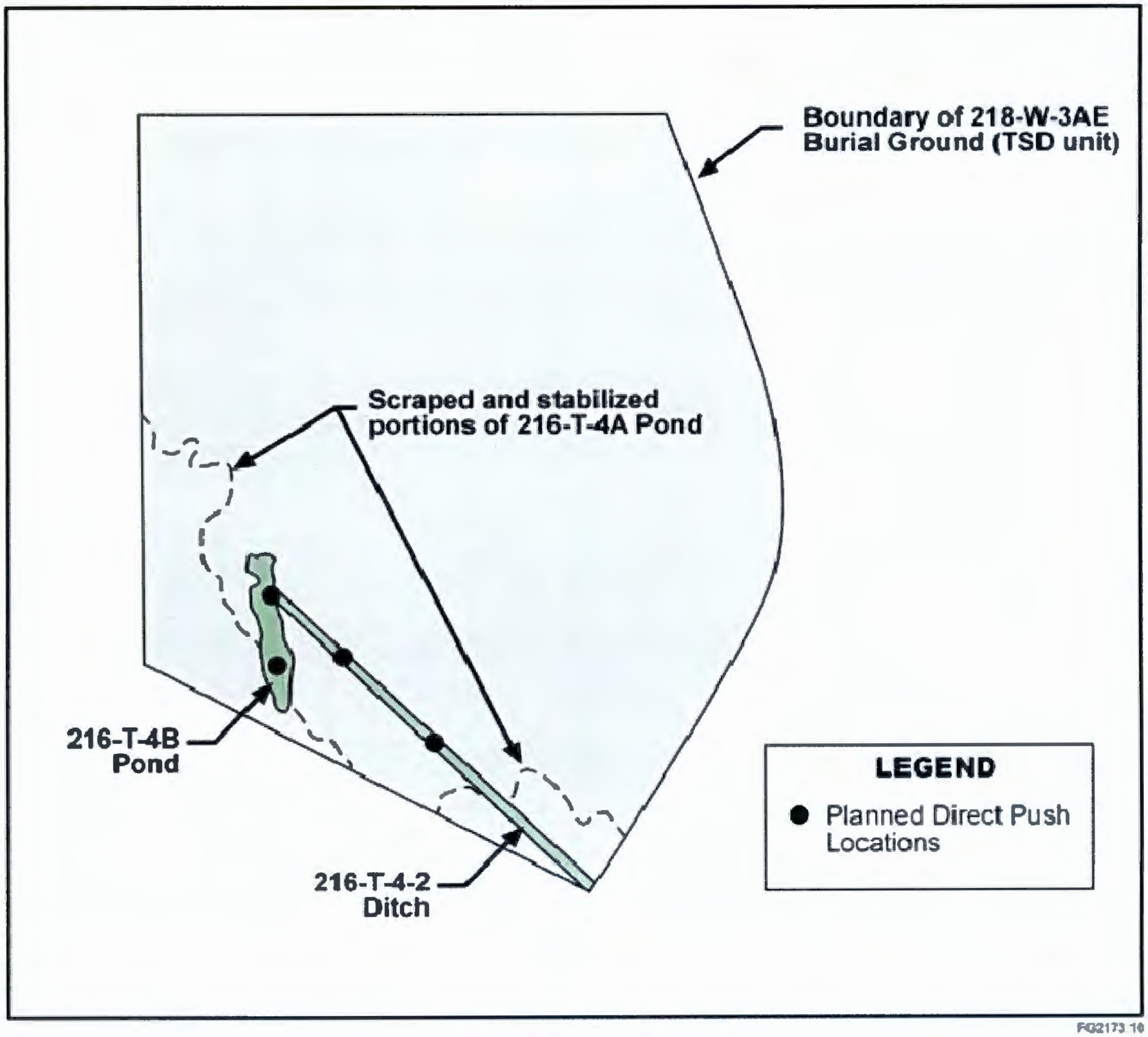

Figure 3-6. 216-U-10 Pond Data Collection Locations.

See Table 3-1 for sample details.

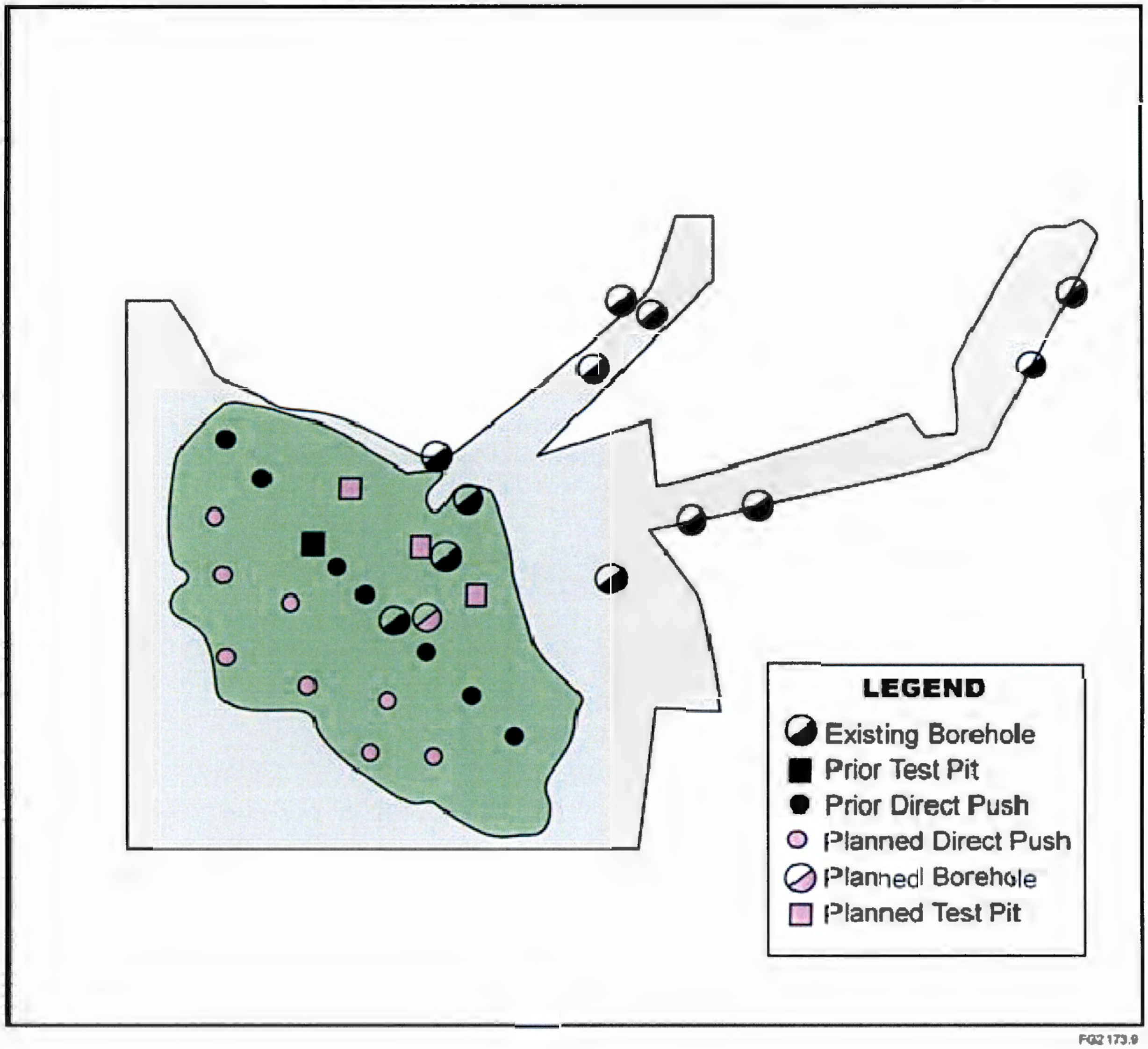

Figure 3-7. 216-U-10 Pond Stratigraphy Column.

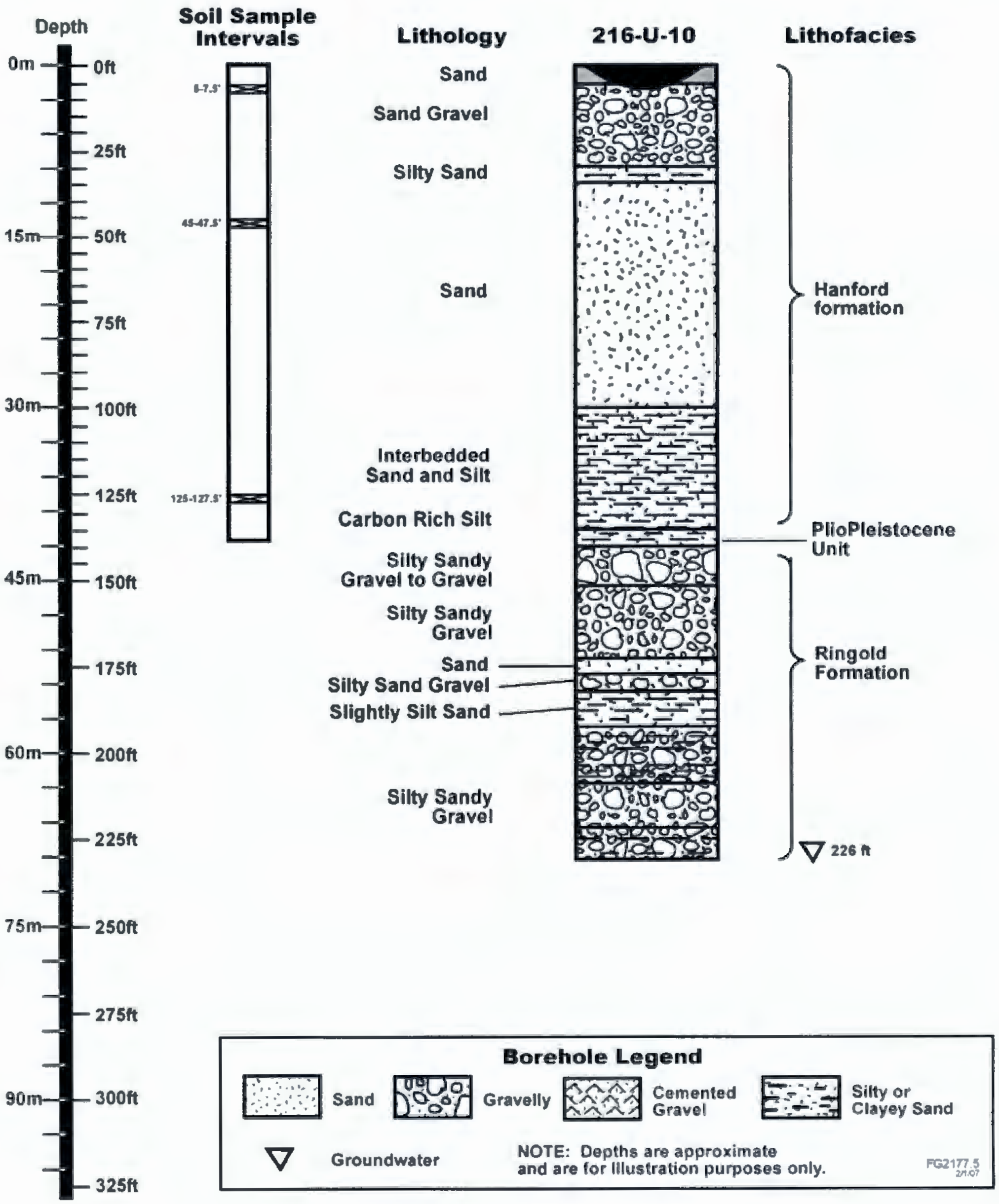

Figure 3-8. 216-U-11 Ditch Sample Locations.

See Table 3-1 for sample details.

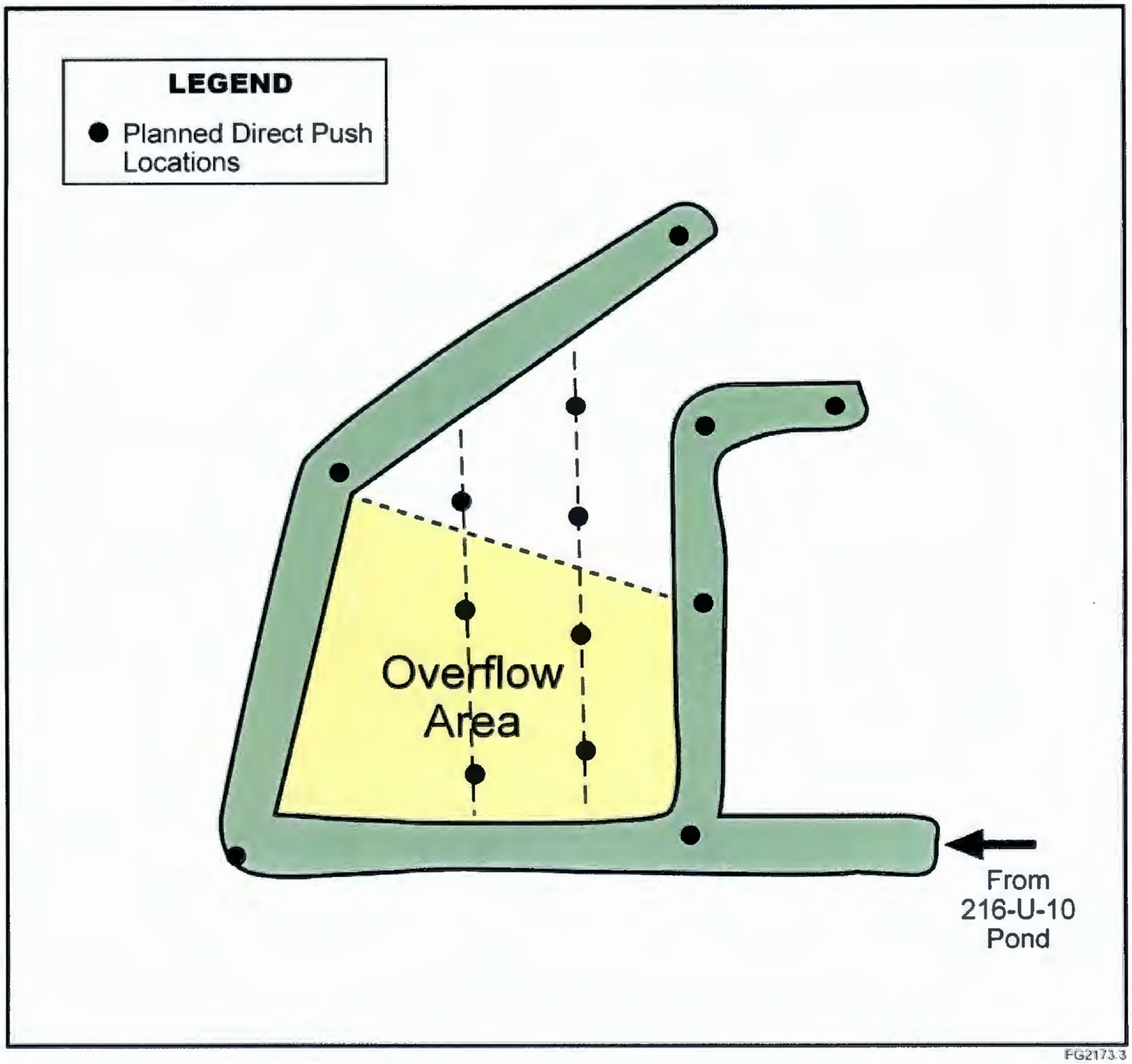

Table 3-1. Key Features of Model Group 5, Large-Area Ponds, Sampling Design. (8 Pages)

Survey or Analytical Methodology	Key Features of Design	Sampling Design Rationale
216-A-25 Gable Mountain Pond		
Geophysical Logging – Direct Push and Small-Diameter Spectral-Gamma Logging Tool	*Medium*: Soil *Specific Location/Area of Concern*: Determine general extent of contamination at this stabilized, secondary overflow area emanating from the northwest corner of the stabilized, primary overflow section (Figure 3-1). *Investigation Method*: Install two (2) direct-push probes to a depth of 6 m (20 ft). The pushes will be located generally as shown on Figure 3-1, based on the highest concentration areas identified by surface radiation surveys as guided by prior flyover reports. Probes will be geophysically logged using small-diameter spectral-gamma logging instruments. *Parameter*: Spectral gamma determined by Cs-137 activity above the logging action level [c]. *Sample(s)*: None considered required or currently planned.	This overflow area was only intermittently wetted and is not reasonably considered to be contaminated at levels above the primary, continually wetted, area that does not require sampling. This location includes hotspots shown by the last flyover (1996) that were stabilized in 1997 with 45.7 to 61 cm (18 to 24-in.) of rock and soil (BHI-01133). However, given that this site is located outside of the industrial-exclusive land-use area, sensitivity exists to other, nonindustrial land uses and potential exposure scenarios. Supplemental data would be helpful in confirming that concentrations in this overflow area are consistent with the primary pond overflow location from which it emanates.

Table 3-1. Key Features of Model Group 5, Large-Area Ponds, Sampling Design. (8 Pages)

Survey or Analytical Methodology	Key Features of Design	Sampling Design Rationale
B Pond		
Geophysical Logging – Direct Push and Small-Diameter Spectral-Gamma Logging Tool	*Medium*: Soil *Specific Location/Area of Concern*: Lateral extent of contamination around BP-1 Test Pit in the 216-B-3 Main Pond. No investigation is planned for the B Pond Lobes. *Investigation Method*: 3-phased investigation approach: **Phase 1**: Three direct pushes will be driven into pond soil surrounding the BP-1 Test-Pit hotspot (see Figure 3-2). One probe will be placed along each of 3 transects between the BP-1 Test-Pit location and Test-Pit BP-3, Test-Pit BP-4, and Borehole B8758. One probe will be driven approximately 7.6 m (25 ft) away from the BP-1 Test Pit along each transect to a depth of approximately 4.6 m (15 ft) below ground surface (bgs). The probes will be logged using small-diameter spectral-gamma instruments capable of detecting Cs-137 concentrations to 1 pCi/g. If logging results at a probe are below the logging action level for Cs-137 [c], no further investigation will be conducted at B Pond. **Phase 2** will occur if spectral gamma, detected at probe location(s), exceeds the logging action level for Cs-137. Continue probe installation <u>outward</u> from the first probe location along the same transect and depth using a 7.6 m (25-ft) interval between probes, until a concentration equal to or less than the logging action level for Cs-137 is reached and the area of elevated contamination is delineated. **Phase 3** will occur if less than the logging action level for Cs-137 is detected at a probe location. Continue probe installation <u>inward</u> from the last probe along the same transect at half the distance between the last probe and the prior probe or the BP-1 Test Pit to refine extent of contamination.	200-CW-1 Remedial Investigation results in DOE/RL-2000-35 indicated that the BP-1 Test Pit had the highest concentrations of contaminants, including Cs-137. Use Cs-137 to determine the extent of contamination radiating out from the BP-1 Test-Pit location. This information could be used to evaluate a partial removal scenario under CERCLA. Four times the action level for Cs-137 (action level for unrestricted use is 6.4 pCi/g) represents the concentration of Cs-137 that would decay within 50 years.
Soil Sampling	*Specific Location/Area of Concern*: Collect one soil sample along the transect with the highest Cs-137 concentration, based on geophysical logging results. Collect the sample at the edge of the area exceeding the Cs-137 logging action level and analyze for RCRA metals and mercury. *Investigation Method*: Sample the soil at the depth of the maximum Cs-137 concentration (corresponding to the bottom of the pond) using the direct-push probe to collect soil. Other field screening techniques, such as hand-held radiation detectors, can be used in conjunction with the above guidance to determine actual sample depths. *Contaminants*: Cadmium, lead, mercury, and Cs-137 [a].	Contamination has been shown through previous sampling to be associated mainly with the pond bottom, approximately 1.8 m (6 ft) bgs. Use soil sampling to determine nonradiological COPC concentrations at the 4 times the Cs-137 extent of the contamination near the BP-1 Test-Pit location.

Table 3-1. Key Features of Model Group 5, Large-Area Ponds, Sampling Design. (8 Pages)

Survey or Analytical Methodology	**Key Features of Design**	**Sampling Design Rationale**
216-S-16 Pond		
Geophysical Logging – Direct Push and Small-Diameter Spectral-Gamma Logging Tool	*Medium*: Soil *Specific Location/Area of Concern*: Nature and extent of contamination emanating radially from the pond inlet through the inlet channel and all pond lobes (4). *Investigation Method*: Twenty-one direct pushes will be driven into pond soil beginning at the pond inlet (see Figure 3-3). Probes will be placed along 5 transects emanating outward from an existing borehole location in the pond inlet and will intersect all 4 pond lobes. The probes will be placed equidistant along the transects and will be driven approximately 4.6 m (15 ft) deep. The probes will be logged using small-diameter spectral-gamma instruments capable of detecting Cs-137 concentrations to 1 pCi/g. *Parameter*: Spectral gamma determined by Cs-137 activity above the logging action level for Cs-137 [c]. *Evolution(s)*: Locations with significant Cs-137 activity will be sampled.	The pond was approximately 1 m (3 ft) deep during operations. After draining, the pond was stabilized with soil from the dikes. The pond bottom is expected at 1 m (3 ft) bgs. Cs-137 is expected based on discharge information and historical data in the work plan (DOE/RL-99-66). Use Cs-137 for tracking contamination by geophysical logging.
Soil Sampling	*Specific Location/Area of Concern*: A minimum of one soil sample will be collected at this waste site from the worst case location and depth, based on geophysical logging results using driven probes. Additional samples will be considered based on the results of geophysical logging and field screening. *Investigation Method*: Sample the soil at the depth of the maximum Cs-137 concentration (corresponding to the bottom of the pond) using the direct-push probe to collect soil. Additional probes can be colocated to obtain sufficient sample volume if needed. Other field-screening techniques, such as hand-held radiation detectors, can be used in conjunction with the above guidance to determine actual sample depths. *Contaminants*: Nonradionuclides include antimony, cadmium, manganese, selenium, total uranium, silver, thallium, toluene, fluoride, cyanide, and nitrate [b]. Radionuclides include Cs-137, Eu-154, Sr-90, Tc-99, Np-237, Pu-239/240, Am-241, and U-238.	Use soil samples to determine other radiological and nonradiological COPC concentrations at selected area(s) of maximum Cs-137 concentrations.

Table 3-1. Key Features of Model Group 5, Large-Area Ponds, Sampling Design. (8 Pages)

Survey or Analytical Methodology	Key Features of Design	Sampling Design Rationale
216-S-17 Pond		
Geophysical Logging – Direct Push and Small-Diameter Spectral-Gamma Logging Tool	*Medium*: Soil *Specific Location/Area of Concern*: Nature and extent of contamination emanating radially from the pond inlet, to include a high-radiation area (15 – 450 mR/h) around the perimeter of the pond. *Investigation Method*: Fifteen direct pushes will be driven into pond soil beginning at the pond inlet (see Figure 3-4). Probes will be placed along 5 transects emanating outward from the pond inlet and will be placed equidistant along the transects to the edge of the historical maximum-use area of the pond as identified by aerial photographs, markers, other historical information, and/or surface geophysics conducted to support the excavation permit. The probes will be driven approximately 4.6 m (15 ft) deep. The probes will be logged using small-diameter spectral-gamma instruments capable of detecting Cs-137 concentrations to 1 pCi/g. *Note*: Refer to the entry for UPR-200-W-124 in this table regarding a possible Phase 2 investigation associated with the 216-S-17 Pond. *Parameter*: Spectral gamma determined by Cs-137 activity above the logging action level for Cs-137 [c]. *Evolution(s)*: Locations with significant Cs-137 activity will be sampled.	The pond was 0.3 to 0.6 m (1 to 2 ft) deep during operations and was stabilized with 1.2 m (4 ft) of soil. Cs-137 is expected to be present based on discharge information and on historical data in the work plan (DOE/RL-99-66). Use Cs-137 for tracking contamination using geophysical logging techniques.
Soil Sampling	*Specific Location/Area of Concern*: Collect a minimum of one soil sample from the worst case location and depth, based on geophysical logging results using driven probes. Additional samples will be considered based on the results of geophysical logging and field screening. *Investigation Method*: Sample the soil at the depth of the maximum Cs-137 concentration (corresponding to the bottom of the pond) using the direct-push probe to collect soil. Additional probes can be colocated to obtain sufficient sample volume if needed. Other field-screening techniques, such as hand-held radiation detectors, can be used in conjunction with the above guidance to determine actual sample depths. *Contaminants*: Nonradionuclides include antimony, cadmium, manganese, selenium, total uranium, silver, thallium, toluene, fluoride, cyanide, and nitrate [b]. Radionuclides include Cs-137, Eu-154, Sr-90, Tc-99, Np-237, Pu-239/240, Am-241, and U-238.	Use soil sampling to determine other radiological and nonradiological COPC concentrations at selected area(s) of maximum Cs-137 concentrations.

Table 3-1. Key Features of Model Group 5, Large-Area Ponds, Sampling Design. (8 Pages)

Survey or Analytical Methodology	Key Features of Design	Sampling Design Rationale
UPR-200-W-124 (overflow area of the 216-S-17 Pond)		
Geophysical Logging – Direct Push and Small-Diameter Spectral-Gamma Logging Tool	*Medium*: Soil *Specific Location/Area of Concern*: Nature and extent of contamination emanating from the dike overflow at the southwest corner of the pond. The exact location of this unplanned release is indeterminate from records. *Investigation Method:* This is a phased investigation (i.e., Phase 2 of the 216-S-17 Pond characterization) that will be performed only if 216-S-17 Pond contamination is found beyond the expected site boundary. This location will be investigated if 216-S-17 Pond contamination levels exceed geophysical logging action levels for Cs-137. The investigation is to determine the location of this unplanned release using direct-push probes in three transects emanating outward from the southwest corner of the Pond (Figure 3-4). The probes will be driven approximately 4.6 m (15 ft) deep. The probes will be logged using small-diameter spectral-gamma instruments capable of detecting Cs-137 concentrations to 1 pCi/g. No sampling is planned for this location. *Parameter*: Spectral gamma determined by Cs-137 activity above the logging action level for Cs-137 [c].	Use Cs-137 for tracking the contamination extent using geophysical logging techniques. Overflow area contaminants would be the same as 216-S-17 Pond contaminants, at the same or lower concentrations.

Table 3-1. Key Features of Model Group 5, Large-Area Ponds, Sampling Design. (8 Pages)

Survey or Analytical Methodology	Key Features of Design	Sampling Design Rationale
216-T-4B Pond		
Geophysical Logging – Direct Push and Small-Diameter Spectral-Gamma Logging Tool	*Medium*: Soil *Specific Location/Area of Concern*: Determine the general extent of contamination in the primary pond location and the ditch that fed the pond. *Investigation Method*: Two direct-push rods will be driven into the ditch site soil and two will be driven into the ditch approximately 6 m (20 ft) deep, as shown in Figure 3-5. The probes will be geophysically logged using small-diameter spectral-gamma instruments. *Parameter*: Spectral gamma determined by Cs-137 activity above the logging action level for Cs-137 [c].	The 216-T-4B Pond and the 216-T-4-2 Ditch that fed the pond are both located within the boundary of the 216-W-3AE Burial Ground RCRA treatment, storage, and disposal unit. The pond is considered to have been dry since 1977 (pre-RCRA), although the ditch received waste until 1995. The ditch and pond received steam condensate and evaporator cooling water from the 242-T Evaporator (a RCRA past-practice unit that ceased operations in 1982) and waste water from the 221-T (T Plant) Canyon Building air conditioning units and floor drains, not known to have been identified as a dangerous waste stream. Extensive contamination is not anticipated. The pond and ditch locations were not investigated and will be investigated under Model Group 5.
Sampling	If Cs-137 concentrations exceed the Cs-137 logging action level [c], collect a minimum of one soil sample from the worst case location. *Contaminants*: Nonradionuclides include antimony, cadmium, manganese, selenium, total uranium, silver, thallium, toluene, fluoride, cyanide, and nitrate [b]. Radionuclides include Cs-137, Eu-154, Sr-90, Tc-99, Np-237, Pu-239/240, Am-241, and U-238.	Sample information will provide initial baseline contaminant information and possibly could assist with closure of the RCRA treatment, storage, and disposal unit.

Table 3-1. Key Features of Model Group 5, Large-Area Ponds, Sampling Design. (8 Pages)

Survey or Analytical Methodology	**Key Features of Design**	**Sampling Design Rationale**
216-U-10 Pond		
Geophysical Logging of Direct Push and Borehole using Small-Diameter Spectral-Gamma Logging Tool	*Medium*: Soil *Specific Location/Area of Concern*: Determine general extent of contamination in the primary pond location and ditch that fed the pond. *Investigation Method*: This investigation will require installation of direct-push probes, test pits, and a borehole as identified in Figure 3-6. Eight direct pushes will be installed to a depth of 6 m (20 ft) as shown in Figure 3-6 and will be geophysically logged for gross gamma from Cs-137. The probes will be logged using small-diameter spectral-gamma instruments. One new borehole approximately 42.7 m (140 ft) deep will be installed in the immediate vicinity of existing Borehole 299-W23-231 (Figure 3-7). The borehole will be geophysically logged. *Parameter*: Spectral gamma determined by Cs-137 activity above the logging action level for Cs-137[c].	Use Cs-137 for tracking the extent of contamination, using geophysical logging techniques.
Sampling	*Test-pit samples*: Test pits at three locations will be installed to locate and identify the depth and thickness of the organic mat. The mat could be located visually or by use of hand-held radiological survey instruments. Once the organic mat at each test pit is located, take two samples – one of the mat material and one of soil directly below the mat – at each of the 3 locations for a total of six test-pit samples. *Borehole sample(s)*: Collect one sample at the pond bottom equating to the pond sediment layer (organic mat). Collect one sample at 4.6 m (15 ft) bgs and one sample at depth (approximately 42.7 m or 140 ft bgs). *Direct-push probe sample(s)*: Collect a minimum of one soil sample from the worst case location of the Cs-137 concentrations that exceed the Cs-137 logging action level[c]. *Contaminants*: Nonradionuclides include antimony, cadmium, manganese, cyanide, selenium, total uranium, silver, thallium, toluene, fluoride and nitrate[b]. Radionuclides include: Cs-137, Eu-154, Sr-90, Tc-99, Np-237, Pu-239/240, Am-241, and U-238.	Test-pit samples will represent the organic mat at the pond bottom and the location of most contamination because of sorption of contaminants onto organic materials. The borehole will be used to clear up an outstanding data quality issue and to evaluate uranium with depth. Push-probe samples taken at the Cs-137 hotspots are intended to represent worst case conditions at the pond and facilitate evaluation of a partial-removal alternative.

Table 3-1. Key Features of Model Group 5, Large-Area Ponds, Sampling Design. (8 Pages)

Survey or Analytical Methodology	Key Features of Design	Sampling Design Rationale
216-U-11 Ditch		
Geophysical Logging – Direct Push and Small-Diameter Spectral-Gamma Logging Tool	*Medium*: Soil *Specific Location/Area of Concern*: Determine general extent of contamination in the primary ditch sections and in the shallow overflow area between the ditch sections. *Investigation Method*: Fourteen direct pushes will be driven into the ditch site soil as shown on Figure 3-8. Seven will be driven into ditch sections, and seven will be driven into the shallow overflow area soils on the interior of the ditch, approximately 3 m (10 ft) deep, and placed along two transects as shown in Figure 3-7. The probes will be logged using small-diameter spectral-gamma instruments. *Parameter*: Spectral gamma determined by Cs-137 activity exceeding the logging action level for Cs-137 [c].	Use Cs-137 to identify the extent of contamination along ditch length and in the shallow overflow area. This ditch was expected to be approximately 1.8 m (6 ft) deep during operations. Because the horseshoe-shaped ditch was fed by overflow from the 216-U-10 Pond, ditch contaminants are expected to be the same as 216-U-10 Pond contaminants. The ditch is known to have overflowed into the interior portion of the south end of the horseshoe shape.

[a] Because of the large body of characterization data available for the representative 216-B-3 Pond waste site, B Pond-specific COPCs for this action are represented by the more focused list of COPCs from Table 5-1 of the 200-CW-1 Operable Unit feasibility study (DOE/RL-2002-69).

[b] This waste site is an analogous waste site to the well-characterized representative waste site 216-U-10 Pond. As a conservative measure because of the absence of data for this analogous waste site, the 200-CW-5 remedial investigation report (DOE/RL-2003-11), Table 6-1, list of 216-U-10 Pond COPCs will be applied and will be expanded to include nitrate (per data quality objectives discussion), U-238 (per WIDS), fluoride and cyanide (identified through STOMP modeling [PNNL-12028]), and Pu-239/240 and Am-241 (identified by earlier 216-U-11 Ditch sampling).

[c] The logging action level for Cs-137 is 24 pCi/g (Section 3.1.1).

BHI-01133, *216-A-25 Pond Overflow Extension (WIDS Site 600-118) Interim Stabilization Final Report/December 1997.*
Comprehensive Environmental Response, Compensation, and Liability Act of 1980.
DOE/RL-99-66, *Steam Condensate/Cooling Water Waste Group Operable Units RI/FS Work Plan; Includes: 200-CW-5, 200-CW-2, 200-CW-4, and 200-SC-1 Operable Units.*
DOE/RL-2000-35, *200-CW-1 Operable Unit Remedial Investigation Report.*
DOE/RL-2002-69, *Feasibility Study for the 200-CW-1 and 200-CW-3 Operable Units and the 200 North Area Waste Sites.*
DOE/RL-2003-11, *Remedial Investigation for the 200-CW-5 U Pond/ Z Ditches Cooling Water Group, the 200-CW-2 S Pond and Ditches Cooling Water Group, the 200-CW-4 T Pond and Ditches Cooling Water Group, and the 200-CS-1 Steam Condensate Group Operable Units.*
PNNL-12028, *STOMP Subsurface Transport Over Multiple Phases, Version 2.0, Application Guide.*
Resource Conservation and Recovery Act of 1976.
Waste Information Data System database.

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980.*
COPC = contaminant of potential concern.
RCRA = *Resource Conservation and Recovery Act of 1976.*
STOMP = subsurface transport over multiple phases.
WIDS = *Waste Information Data System.*

Table 3-2. Summary of Model Group 5 Sample Collection Requirements.

Site	Sample Collection Methodology	COPCs	Sample Location Information				Analytical Requirements and Parameters [c]	
			Sample Location [a]	Sample Depth [b] (ft bgs)	No. of Samples	No. of Field Quality Control Samples	Radio-nuclides	Nonradio-nuclides
216-B-3 Pond	Direct Push	Table 3-1	Footnote a	≤ 15 ft bgs	1 [f]	2 [d]	Table 2-1	Tables 2-2
216-S-16 Pond	Direct Push	Table 3-1	Footnote a	≤ 15 ft bgs	1 [f]	3 [e]	Table 2-1	Tables 2-2
216-S-17 Pond	Direct Push	Table 3-1	Footnote a	≤ 15 ft bgs	1 [f]	3 [e]	Table 2-1	Tables 2-2
216-T 4B Pond	Direct Push	Table 3-1	Footnote a	≤ 20 ft bgs	1 [f]	3 [e]	Table 2-1	Table 2-2
216-U-10 Pond	Test pits (3)	Table 3-1	Sediment layer and 1 ft below (Fig 3-6)	(TBD)	2 at each test pit (6 total)	3 [e]	Table 2-1	Tables 2-2
	Borehole (2)		Sediment layer, 15 ft bgs and depth (140 ft bgs) (Fig 3-6)	Sediment layer (TBD), 15 ft bgs and 140 ft bgs	3		Table 2-1	Tables 2-2
	Direct Push		TBD (Fig 3-6)	< 20 ft bgs	1 [f]		Table 2-1	Tables 2-2
Total number of samples		13						
Minimum number of field quality control samples		14						
Total number of samples for all sites		27 [e]						

[a] Sampling at direct-push probe locations will occur under the conditions described in Table 3-1.

[b] Sample depth is limited to direct-push depth of 4.6 (15 ft) bgs. Sample interval (if multiple samples are required) will be guided by the depth of Cs-137 concentration found by geophysical logging to exceed the Cs-137 logging action level (Table 3-1).

[c] See Tables 2-1 and 2-2 for detection limits and other analytical parameters.

[d] At a minimum, one duplicate and one equipment blank will be taken at this sampled waste site

[e] At a minimum, one duplicate, one equipment blank, and one trip blank will be taken at this sampled waste site.

[f] This is the minimum required number of samples at a waste site where Cs-137 concentrations exceed the logging action level for Cs-137 of 24 pCi/g (Section 3.1.1). Therefore, a sample may not be required at this site, if Cs-137 concentrations do not exceed the logging action level for Cs-137 of 24 pCi/g. However, additional samples may be considered at this site, based on results of geophysical logging and field screening (Table 3-1).

bgs = below ground surface.

TBD = to be determined.

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4.0 HEALTH AND SAFETY

All field operations will be performed in accordance with PHMC health and safety requirements and with the applicable health and safety plan generated, following all appropriate procedures. The site-specific health and safety plan must meet the requirements of 40 CFR 300.430, "Remedial Investigation/Feasibility Study and Selection of Remedy," which requires the health and safety plan to specify, at a minimum, employee training and protective equipment, medical surveillance requirements, standard operating procedures, and a contingency plan that conforms to 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response." The health and safety plan includes controls for industrial safety and radiological hazards, an incident contact list, and emergency response procedures (i.e., area alarms, fire, dust, biological hazards). The health and safety plan also identifies different work zones (e.g., exclusion zone, control zone, support zone) to maintain ALARA principles.

In addition, a work control package will be prepared in accordance with procedures that will further control waste-site operations. This package will include an activity job-hazard analysis, a site-specific health and safety plan, and applicable radiological work permits. Radiological work permits provide specifics about the radiological survey of equipment, materials, and personnel, radiological control technician coverage, specific personal protective equipment, dosimetry requirements, and special instructions for the work site. Work will be performed in accordance with site-specific health and safety plans and applicable radiological work permits.

The sampling procedures and associated activities described in the FS (Chapter 3.0) will take into consideration exposure reduction and contamination control techniques that will minimize the radiation exposure to the sampling team.

Health and safety personnel will use data collected during the removal action as input to determine exposure levels to workers and to conduct health and safety assessments in accordance with the health and safety plan.

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5.0 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

Waste generated by data-collection activities at the Model Group 5 waste sites will be managed consistent with the existing, approved waste control plan for each of the OUs represented by this model group, and/or with new waste control plan(s) yet to be developed for the activity.

Offsite laboratories to be used for sample analysis are licensed to manage and dispose of unused sample material. Returns from offsite laboratories are not expected. However, sample material from onsite or offsite laboratories will be managed as sample returns and will be dispositioned with the IDW for the waste site in accordance with the approved waste control plan.

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6.0 REFERENCES

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29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response," Title 29, *Code of Federal Regulations*, Part 1910.120, as amended.

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APPENDIX A

MODEL GROUP 5, LARGE-AREA PONDS, DATA QUALITY OBJECTIVES SUMMARY

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CONTENTS

FIGURES

TABLES

TERMS

AA	alternative action
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COPC	contaminant of potential concern
DQO	data quality objective
DR	decision rule
DS	decision statement
Ecology	Washington State Department of Ecology
EMI	electromagnetic imaging
EPA	U.S. Environmental Protection Agency
FS	feasibility study
GPR	ground-penetrating radar
HPGe	high-purity germanium
HRR	high-resolution resistivity
K_d	distribution coefficient
N/A	not applicable
NaI	sodium iodide
PS	problem statement
PSQ	principal study question
RCRA	*Resource Conservation and Recovery Act of 1976*
RESRAD	RESidual RADioactivity (dose model) (ANL, 2002)
RESRAD-BIOTA	*RESRAD-BIOTA*, Version 1.2 Software (ANL, 2006)
RI/FS	remedial investigation/feasibility study
RL	U.S. Department of Energy, Richland Operations Office
ROD	record of decision
SAP	sampling and analysis plan
SGL	spectral gamma-ray logging
STOMP	Subsurface Transport Over Multiple Phases (PNNL-12028)
TBC	to be considered
WIDS	*Waste Information Data System* database

METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
If you know	*Multiply by*	*To get*	*If you know*	*Multiply by*	*To get*
Length			**Length**		
inches	25.40	millimeters	millimeters	0.0394	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles (statute)	1.609	kilometers	kilometers	0.621	miles (statute)
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.0929	sq. meters	sq. meters	10.764	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.591	sq. kilometers	sq. kilometers	0.386	sq. miles
acres	0.405	hectares	hectares	2.471	acres
Mass (weight)			**Mass (weight)**		
ounces (avoir)	28.349	grams	grams	0.0353	ounces (avoir)
pounds	0.454	kilograms	kilograms	2.205	pounds (avoir)
tons (short)	0.907	ton (metric)	ton (metric)	1.102	tons (short)
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.034	ounces (U.S., liquid)
tablespoons	15	milliliters	liters	2.113	pints
ounces (U.S., liquid)	29.573	milliliters	liters	1.057	quarts (U.S., liquid)
cups	0.24	liters	liters	0.264	gallons (U.S., liquid)
pints	0.473	liters	cubic meters	35.315	cubic feet
quarts (U.S., liquid)	0.946	liters	cubic meters	1.308	cubic yards
gallons (U.S., liquid)	3.785	liters			
cubic feet	0.0283	cubic meters			
cubic yards	0.764	cubic meters			
Temperature			**Temperature**		
Fahrenheit	(°F-32)*5/9	Centigrade	Centigrade	(°C*9/5)+32	Fahrenheit
Radioactivity			**Radioactivity**		
picocurie	37	millibecquerel	millibecquerel	0.027	picocurie

APPENDIX A

MODEL GROUP 5, LARGE-AREA PONDS, DATA QUALITY OBJECTIVES SUMMARY

A1.0 INTRODUCTION

This Appendix summarizes the data quality objectives (DQO) process for the Model Group 5, Large-Area Ponds, waste sites. This process was initiated to identify the sites in this model group that require supplemental data to make a remedial decision and to identify the data and quality of data necessary to support the remedial decision-making process.

A2.0 DATA QUALITY OBJECTIVES

To ensure that data quality requirements are met, the sampling design developed during this DQO was established through the U.S. Environmental Protection Agency (EPA) seven-step DQO process (EPA/240/B-06/001, *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4). To date, the DOQ process workshops for the Model Group 5 Large-Area Ponds waste sites occurred on 10/20/05, 10/27/05, 11/07/05, 11/17/05, 8/16/05, and 09/07/06. The sampling design developed in the DQO and described in this section has been carried forward to the field sampling plan (main text Chapter 3.0). The seven-step DQO process and the key DQO outputs are summarized here.

A2.1 DATA QUALITY OBJECTIVES STEP 1: STATEMENT OF THE PROBLEM

Step 1 defines the problem in a problem statement and identifies potential applicable or relevant and appropriate requirements (ARAR). The nature and extent of contamination and the associated potential risks for each Model Group 5, Large-Area Ponds, waste site were evaluated during the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) remedial investigation/feasibility study (RI/FS) process for the respective operable units (i.e., 200-CS-1, 200-CW-1, 200-CW-2, 200-CW-4, 200-CW-5). However, data gaps potentially could exist that would require additional data collection at these sites to support RI/FS process remedial decision making and to verify or refine the conceptual contaminant distribution model. To address potential data gaps, site-characterization data and historical information will be evaluated further to determine what, if any, additional information is necessary. To that end, the activities of this DQO will include defining data gaps and needs, identifying appropriate data-collection methods, and identifying data-collection strategies. The sampling design developed in this DQO process will be carried forward in a combined DQO/sampling and analysis plan (SAP) that will specify field-characterization requirements.

Problem Statement. To support remedial-alternatives evaluation in the feasibility study and final remedial decision making for some Model Group 5 Large-Area Ponds waste sites, supplemental data are needed.

The ARARs for this DQO process and for the data-collection activities are shown in Table A-1.

A joint interview was conducted with the EPA, the Washington State Department of Ecology (Ecology), and the U.S. Department of Energy, Richland Operations Office (RL) to identify their objectives, requirements, and concerns relating to this data-collection activity. Interview comments are summarized below.

- Decision makers agreed that the primary objective of this DQO process was evaluation of existing waste-site characterization data and site information to determine what, if any, additional information was necessary to support remedial decision making and/or to refine the preliminary conceptual contaminant distribution model.
- Collect sufficient defensible characterization data to support remedial decisions that are defensible and traceable.
- Obtain data that possibly could help minimize the need for long-term institutional controls, and identify where unrestricted use requirements possibly could be met.
- Identify the data required to support selection of the best remedial alternative, when several alternatives reasonably could be combined at the same waste site (e.g., removal/treatment/disposal, cap).
- Data collection should be broad ranging, using field-screening techniques that provide a larger body of data, with less emphasis on expensive laboratory analytical data from a single location.
- For most of these model group sites, more extensive and broad-based waste site information (i.e., more data and information versus less analytical sample data) obtained by use of faster, real-time (and lower cost) field-screening techniques generally is preferable to limited, slower, higher cost laboratory analytical data.
- Data needs (i.e., broad versus specific) can vary on a case-by-case basis, based on the remedial alternative under consideration.
- Sampling designs must support site distinctions and provide appropriate data, based on the site needs; e.g., sites for which barriers or natural attenuation are being considered require more extensive data than sites for which the removal/treatment/disposal alternative is being considered and the observational approach can be applied.
- DQO decision units may need to be focused downward from the whole site to a portion of a site for remedial decision making, particularly when a segment of the site may be clean, while another portion may be contaminated and require remediation.
- The baseline assumes that the monitored natural attenuation/maintain existing soil cover or barrier alternatives will be sufficiently protective for model group waste sites.
- Ecological risk needs to be included in this DQO.

- The goal of RI/FS characterization activities for the pond waste sites is to attain 95 percent upper confidence limit, but this does not preclude the use of other statistics, such as a mean value, when appropriate.

Later DQO discussions identified the following decision-maker positions.

- Supplemental data primarily will be requested (1) to meet a technical need (data gap), (2) where new data can impact remedy selection, and/or (3) where new data could facilitate future land-use decisions. Where data are requested for other reasons, the rationale should be identified clearly.

- Some pre-record of decision (ROD) supplemental data may be allowed to take the place of post-ROD confirmatory sampling. However, it is likely that some post-ROD confirmatory sampling still will be required, particularly at uncharacterized analogous waste sites.

A2.2 DATA QUALITY OBJECTIVES STEP 2: IDENTIFY THE DECISIONS

Step 2 develops principal study questions (PSQ) that need to be resolved to address the problems and project objectives identified in DQO Step 1 and defines the alternative actions that would result from resolution of the PSQs. The PSQs and alternative actions are combined into decision statements that express a choice among the alternative actions. Table A-2 presents the task-specific PSQs, alternative actions, and resulting decision statements. This table also provides a qualitative assessment of the severity of the consequences of taking an incorrect alternative action and expresses the severity of consequences for an incorrect action as low, moderate, or severe. This assessment takes into consideration human health and the environment (i.e., flora/fauna).

A2.3 DATA QUALITY OBJECTIVES STEP 3: IDENTIFY INPUTS TO THE DECISION

DQO Step 3 identifies the data needed to resolve each of the decision statements developed in Step 2. Table A-3 identifies information needs and enables evaluation of the adequacy of existing data for remedial-alternative selection. This step also identifies the analytical performance requirements (e.g., practical-quantitation-limit requirement, precision, and accuracy) to support required data. This information is derived from the list of contaminants of potential concern (COPC) (DQO Step 5).

The following discusses the rationale for data collection at the Model Group 5 Large-Area Ponds presented in Table A-3.

216-A-25 Pond. Decision makers agreed that existing data potentially were insufficient to make a remedial decision for the 216-A-25 Gable Mountain Pond because of the absence of data for the overflow area at the northwest corner of the pond. Proposed data collection approach/locations are based on results of 'flyover' surveys performed in 1978, 1988, and 1996 that identified elevated contamination at a potential overflow area of the pond. The main overflow area was stabilized in the mid-1980s. Hot-spot locations shown by the most recent flyover (1996) were stabilized in 1997 with 45.7 to 61 cm (18 to 24-in.) rock and soil (BHI-01133, *216-A-25 Pond Overflow Extension (WIDS Site 600-118) Interim Stabilization Final Report/December 1997*). The location is now posted as an Underground Radioactive Materials area. Additional data would be helpful in confirming that concentrations in this overflow area are consistent with the primary pond overflow location from which it emanates. The rationale for this sampling reflects increased stakeholder sensitivity for this site, because it is located outside of the Core Zone and reflects a desire to ensure that the site is properly stabilized.

216-B-3 Pond (Main Pond). Decision makers agreed that more data are required to define the extent of contamination around the BP-1 Test-Pit location, where the highest levels of contamination were found. Additional data collection near the BP-1 Test Pit will help to better understand the reason for that area having the highest contamination. Clarifying data are needed because, contrary to normal contaminant distribution models that anticipate higher contamination levels near the waste inlet (B8758 Borehole), contamination levels were highest near the BP-1 Test Pit, which is not near the inlet. Additional data collection also should allow a more focused partial-removal-alternative evaluation. RL felt that existing data are adequate to support a decision for the entire pond but agreed that the recommended supplemental data should support assessment of a partial-removal alternative that may allow reduced long-term controls under the currently identified preferred alternative of maintain existing soil cover, monitored natural attenuation, and institutional controls, thereby providing cost benefits. The data collection described does not add significantly to the overall cost, because the primary contaminant of concern is Cs-137, which is readily detectable with field-screening and geophysical-logging instruments. Field screening would be followed by sampling at select location(s) showing Cs-137 above action levels.

216-B-3 Pond Lobes (216-B-3A Pond, 216-B-3B Pond, 216-B-3C Pond). Decision makers agreed that supplemental data for these sites are not required to make a remedial decision. Because the lobes have been clean closed under the *Resource Conservation and Recovery Act of 1976* (RCRA), the remaining action is focused on radionuclides. The DQO discussion centered around the data collected during RCRA closure. An issue was raised concerning data quality, which was not assessed in the supporting closure plan or closure report. The EPA agreed that data were sufficient to make a remedial decision, pending a review of the quality of the radiological data. The EPA indicated that they believed that data likely were adequate, based on their understanding of the closure documents. Radiological sample-analysis and -validation information indicate that the samples were analyzed at a laboratory that met detection limits requirements and that the data were validated appropriately.

216-S-10 Pond. Decision makers agreed that existing data were sufficient to make a remedial decision for the 216-S-10 Pond and that supplemental data are not required for this site to make a remedial decision.

216-S-16 Pond. Decision makers agreed that data were not sufficient to make a remedial decision for the 216-S-16 Pond and that supplemental data would be collected for this pond. A historical sampling report for this site was discussed, but the data supporting the report could not be located. The analogous relationship of the 216-S-16 Pond to the 216-U-10 Pond (U Pond), and to other ponds in general, can support decision making. However, site-specific accelerated confirmatory data may provide a stronger alternative evaluation of a partial-excavation alternative. Some uncertainty exists in the analogous waste-site relationship, especially with regard to distribution of contaminants among the lobes of the pond and the potential for selenium contamination (a risk driver for the 216-U-10 Pond), which may not be associated with this pond because of differing waste streams. Initially, data will be collected using field-screening techniques, followed up with sampling on an as-needed basis.

216-S-17 Pond. Decision makers agreed that data potentially were insufficient to make a remedial decision for the 216-S-17 Pond, because no site-specific historical data were identified. No specific data needs were identified during the DQO discussion. While the analogous relationship of the 216-S-17 Pond to the U Pond and to other ponds in general can support decision making, decision makers agreed that site-specific accelerated confirmatory data may provide a stronger alternative evaluation, especially for a partial-excavation alternative. Some uncertainty exists in the analogous waste-site relationship, especially with regard to distribution of contaminants, impacts of the overflow area (UPR-200-W-124), and the potential for selenium contamination, which was identified as a risk driver at the U Pond, but may not be associated with this pond because of differing waste streams. Initially, data will be collected using field-screening techniques, with follow-up sampling of select locations showing Cs-137 contamination above action levels.

UPR-200-W-124. Decision makers agreed that this unplanned release will be addressed as a portion of the 216-S-17 Pond, consistent with the other pond-overflow areas. This unplanned release exists as a *Waste Information Data System* (WIDS) database site that was a release from the southwest corner of the 216-S-17 Pond and so is contiguous with the pond proper. Release records identify the size of the release but are indeterminate regarding the exact location. Supplemental 216-S-17 Pond data that are being collected to identify the lateral extent of pond contamination will be considered in addressing the unplanned-release area of concern. If 216-S-17 Pond data are found to exceed contaminant action levels (i.e., greater than 4 times the 15 mrem action level for Cs-137 of 6.4 pCi/g) in the vicinity of the overflow, using GeoProbe[1] and geophysical logging techniques, the extent of the overflow will be investigated.

216-T-4A Pond. Decision makers agreed that the 216-T-4A Pond site would be withdrawn from Model Group 5 and placed in Model Group 1 (minimal action sites). This decision was made based on the following: (1) the site now resides within the boundaries of the 216-W-2A Burial Ground and (2) the site is considered relatively clean since having undergone significant remediation in 1973, when the pond bottom (including the organic mat) was scraped to a depth of 15 to 23 cm (6 to 9 in.) and the material was put in 216-W-2A Burial Ground trenches.

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[1] GeoProbe is a registered trademark of GeoProbe Systems, Salina, Kansas.

216-T-4B Pond. Decision makers agreed that data were not sufficient to make a remedial decision for the 216-T-4B Pond, because little site-specific historical data or information currently are available to support a decision. Both the pond and the 216-T-4-2 Ditch that fed the pond are located within the boundary of the 216-W-3AE Burial Ground RCRA treatment, storage, and disposal unit. However, the pond and ditch are not within the area of permitted treatment, storage, and disposal- (TSD-) unit burial-ground operations, and liquid-effluent disposal never was a portion of permitted TSD-unit operations. The ditch and pond received low-level steam condensate and evaporator cooling water from the 242-T Evaporator (a RCRA past-practice unit that ceased operations in 1982) and nonradioactive waste water from the 221-T (T Plant) Canyon Building air conditioning units and floor drains. The pond is considered to have been dry since 1977 (pre-RCRA) and, although the ditch received waste until 1995, this effluent is not known to have been identified as a dangerous waste stream that would have required permitted disposal under RCRA. Extensive contamination is not anticipated at this pond and ditch site. The pond is not visible and is not separately marked or posted from burial-ground postings. Because the pond and ditch were not part of TSD-unit operations, these sites will be addressed under past-practice processes and investigated under the Model Group 5 supplemental data-collection activities.

216-U-10 Pond. Decision makers agreed that more data would be necessary to reconcile two inconsistencies in prior site data. One inconsistency was associated with a stakeholder concern that this pond may have a larger uranium inventory than was indicated by earlier 200-UP-2 Groundwater Operable Unit remedial investigation sampling. A review of the document identified by the stakeholder does not provide sufficient information to assert that uranium concentrations were higher than those identified through the remedial investigation. Interviews with the author of the document did not result in location of the supporting data. Requests to the laboratory similarly did not help in locating the data. While the document does briefly mention some higher concentrations, the theme of the document is focused on plutonium and not uranium. The other inconsistency arose from a likely sample-handling error by the analytical laboratory that led to a spurious indication of deep soil contamination at the 216-U-10 Pond. The sample-handling error involved the accidental mix-up of sample material in the laboratory, resulting in data from a different site inappropriately being assigned to the 216-U-10 Pond. Although the evidence of a data mix-up is fairly clear, the data quality was compromised, making the result subject to reverification. Data collection could use a phased approach, beginning with logging to locate the contaminated organic mat of the pond bottom, which then could be sampled more accurately.

216-U-11 Ditch. Decision makers agreed that existing data are not sufficient to make a remedial decision for the 216-U-11 Ditch. The EPA noted that more data would be needed to identify the lateral extent of contamination. Decision makers agreed that the 216-U-10 Pond data could be used for evaluating the contaminants at the 216-U-11 Ditch and that the analogous relationship between the U Pond and the 216-U-11 Ditch is sufficient to make remedial decisions. However, decision makers agreed to collect some accelerated confirmatory data using GeoProbes and geophysical logging to determine the lateral extent of contamination. These data could support a site-specific assessment of a partial-removal alternative that may influence the currently identified preferred alternative, especially in the overflow area, which may have a different distribution than the ditch areas. These supplemental data may show that only a small portion of the ditch is contaminated, greatly reducing cap size and/or excavation volume.

Table A-4 identifies each decision statement and presents computational and survey/analytical methods that could be used to obtain the required data.

Table A-5 identifies each of the survey and/or analytical methods that may be used to provide the required information needed to resolve each decision statement. The possible limitations associated with each of these methods also are provided.

The analytical performance requirements are provided in the quality assurance project plan in main text Chapter 2.0.

A2.4 DATA QUALITY OBJECTIVES STEP 4: DEFINE THE BOUNDARIES OF THE STUDY

The primary objective of DQO Step 4 is to identify the spatial, temporal, and practical constraints on the sampling design and to assess the consequences. This assessment facilitates a sampling design that results in the collection of data that accurately reflect the true condition of the site and/or populations being studied.

Tables A-6, A-7, and A-8 address considerations in defining the boundaries of the study. Table A-6 defines the population of interest that clarifies what the samples are intended to represent and presents the characteristics that define this population.

The boundary of the study includes spatial boundaries that make up the domain within which all of the decisions apply. The spatial boundary is a region distinctly defined by quantifiable, physical variable(s) (e.g., volume, length, width, geographic boundary). Table A-7 identifies the geographic boundaries of this investigation.

Table A-8 shows how the population sometimes can be divided into strata that have relatively homogeneous characteristics. Rationale for alignment of the population into strata with homogeneous characteristics was derived from evaluation of process knowledge, historical data, and pond-site configuration. Based on Table A-8, the preliminary site conceptual model suggests that highest contaminant concentrations should be detected directly beneath the pond bottom, particularly at the sediment layer and decreasing with depth. Contaminants released likely would impact the soil directly beneath the pond and, to a lesser degree, laterally. Therefore, focusing the data collection in and around the ponds should identify the lateral spread of contamination.

For this DQO, the zones with the homogeneous characteristics in Table A-8 are not significant factors in remedial decision making. Rather, the homogeneous zones are related to the preliminary conceptual contaminant distribution model and primarily help to focus data collection. The remedial decision making will be based on contaminant concentrations and depth. This affects the spatial scale of decision making addressed later in this step.

The temporal boundaries of the decision determine the timeframe to which decisions apply. The temporal boundaries of the decision for this data-collection activity are defined in Table A-9 and reflect that minimal temporal limitations exist.

The scale of decision making is defined as the smallest, most appropriate subsets of the population (subpopulation) for which decisions will be made based on the spatial or temporal boundaries of the area under investigation. Table A-10 defines the scale of decision making for each decision statement for this DQO. The scale of decision making for this DQO process is the vadose-zone soils within the geographic boundaries of the individual waste sites over the next 0 to 5 years, as quantified in Table A-9. Remedial decision making will be based on contaminant concentration and depth within vadose-zone soils. Because the pond sites have not been implicated in groundwater contamination, the scale of decision making generally will be limited to shallower vadose-zone soils (4.57 m [15 ft] bgs) as the point of compliance for human health and ecological risk potentially presented by these sites,. However, because the contaminant-concentration gradients and associated depths are not known, the depth of vadose-zone soil within the scale of decision making will be determined on a site-specific basis. Figure A-1 further identifies the spatial scale of decision making with regard to potential contaminant distribution within the pond sites, based on proximity to the waste inlet.

Table A-11 identifies the practical and other constraints that may impact the data collection. These constraints can include physical barriers, difficult sample matrixes, high-radiation areas, or any other condition that requires consideration in the design and scheduling of data collection.

A2.5 DATA QUALITY OBJECTIVES STEP 5: DECISION RULES

Step 5 develops decision rules from the combined results of DQO Steps 2, 3, and 4. Initially, Step 5 identifies the statistical parameter of interest (i.e., maximum, mean, or 95 percent upper confidence level) that will be used for comparison against preliminary action level(s) that also are developed in this step for each COPC. The statistical parameter of interest specifies the characteristic or attribute that a decision maker would like to know about the population. Once the parameter of interest and the preliminary action levels are established, a decision rule is developed for each decision statement in the form of an "IF…THEN…" statement that incorporates the parameter of interest, the scale of decision making (from Step 4), the preliminary action level, and the alternative actions (from Step 2) that would result from resolution of the decision. The information needed to formulate the decision rules is identified in Table A-12.

Of the 13 Model Group 5 waste sites, supplemental data will be collected at the 216-A-25 Pond, 216-B-3 Pond, 216-S-16 Pond, 216-S-17 Pond (and associated UPR-200-W-124), 216-T-4B Pond, 216-U-10 Pond, and the 216-U-11 Ditch (Table A-3). The COPCs for supplemental data collection were identified through the RI/FS process for these sites as primarily risk drivers.

The COPCs for the 216-B-3 Pond, because of the large body of characterization data available for this representative waste site, are represented by the more focused list of COPCs from DOE/RL-2002-69, *Feasibility Study for the 200-CW-1 and 200-CW-3 Operable Units and the 200 North Area Waste Sites*, Table 5-1.

The COPCs for the well-characterized 216-U-10 Pond representative waste site, and for its analogous 216-S-16 and 216-S-17 Ponds waste sites, will, as a conservative measure, be the

DOE/RL-2003-11, *Remedial Investigation for the 200-CW-5 U Pond/ Z Ditches Cooling Water Group, the 200-CW-2 S Pond and Ditches Cooling Water Group, the 200-CW-4 T Pond and Ditches Cooling Water Group, and the 200-CS-1 Steam Condensate Group Operable Units*, Table 6-1, list of 216-U-10 Pond COPCs. The Table 6-1 list of COPCs carried forward to the FS will be used, except that diethylphthalate, di-n-butyl-phthalate, and Se-79 will be excluded, because these are not actually expected to exist in site soils, and even if they exist in site soils, they could not reasonably exist at concentrations that would require their consideration as primary risk drivers.

- The diethylphthalate and di-n-butyl-phthalate are of the phthalates group that constitutes common laboratory contaminants at the concentrations found in the 216-U-10 Pond samples, are not anticipated to have persisted in pond soils at any significant concentrations, and so are likely laboratory artifacts.
- Se-79 will be excluded, because (1) no established cleanup level exists (i.e., no EPA established drinking-water maximum contaminant level); (2) it is on the list of "Excluded 200 Area COPCs," being generated at less than 5×10^{-5} times Cs-137 activity; and (3) it likely is not in pond waste-site soils (there are no laboratory standards for Se-79, making Se-79 results in 216-U-10 Pond soil samples dubious and mostly the result of spectral analysis of other, more common radionuclide(s)).

For conservatism, the Table 6-1 COPCs list will be expanded to include nitrate (per DQO discussion); U-238 (per WIDS); Tc-99, fluoride and cyanide (identified through subsurface transport over multiple phases [STOMP] modeling [PNNL-12028, *STOMP Subsurface Transport Over Multiple Phases, Version 2.0, Application Guide*.]); and, Pu-239/240 and Am-241 (identified by earlier 216-U-11 Ditch sampling).

The 216-T-4B Pond received only low-contaminant 242-T Evaporator steam condensate/condenser cooling water and waste water from the 221-T (T Plant) Canyon Building air conditioning filter units and floor drains. However, as a conservative measure, any 216-T-4B Pond samples also will use the expanded list of 216-U-10 Pond COPCs.

Tables A-13 and A-14 identify radionuclide and nonradionuclide COPCs, respectively, and their preliminary action levels. Target quantitation limits and precision and accuracy requirements, as implemented by laboratory quality assurance procedures, are identified in Tables 2-1 and 2-2 (main text Chapter 2.0).

The Model Group 5 decision rules are identified in Table A-15.

A2.6 DATA QUALITY OBJECTIVES STEP 6: TOLERABLE LIMITS ON DECISION ERRORS

Analytical data are used to estimate the true condition of the site under investigation. Consequently, decisions that are made based on measurement data potentially could be in error (i.e., decision error). The possible consequences for each decision rule are (1) remediating a clean site at additional time on site and cost or (2) not adequately remediating a contaminated site, therefore leaving a site that is not protective of human health and the environment. Because these sites are not expected to be highly contaminated (Table A-2), for this DQO, the consequence of selecting an inadequate sampling design can range from low to moderate for ecological and human-health risks, respectively.

A2.7 DATA QUALITY OBJECTIVES STEP 7: DATA COLLECTION AND SAMPLE DESIGN

Data-collection locations and sampling methods have been selected that resolve the decision statements and provide information regarding sample parameters, A two-phased investigation approach will be used to identify the horizontal and lateral extent of contamination that relies on geophysical logging to determine appropriate locations, if any, for soil sampling. Field geophysical logging of direct-push probes will be used to identify where gross gamma from Cs-137, a pervasive and persistent COPC for all sites, exceeds logging action levels. Additional samples may be collected at the discretion of the site Sample and Data Management Lead, based on conditions encountered and field-screening data. This approach increases the likelihood of encountering maximum contaminant concentrations (i.e., the worst case conditions) for focused sampling. Table A-16 identifies the methods and key features of the data collection at pond waste sites for which existing data are not sufficient to make a remedial decision. This sampling design will be carried forward to the field-sampling plan (main text Chapter 3.0).

Figure A-1. Spatial Scale of Decision Making.

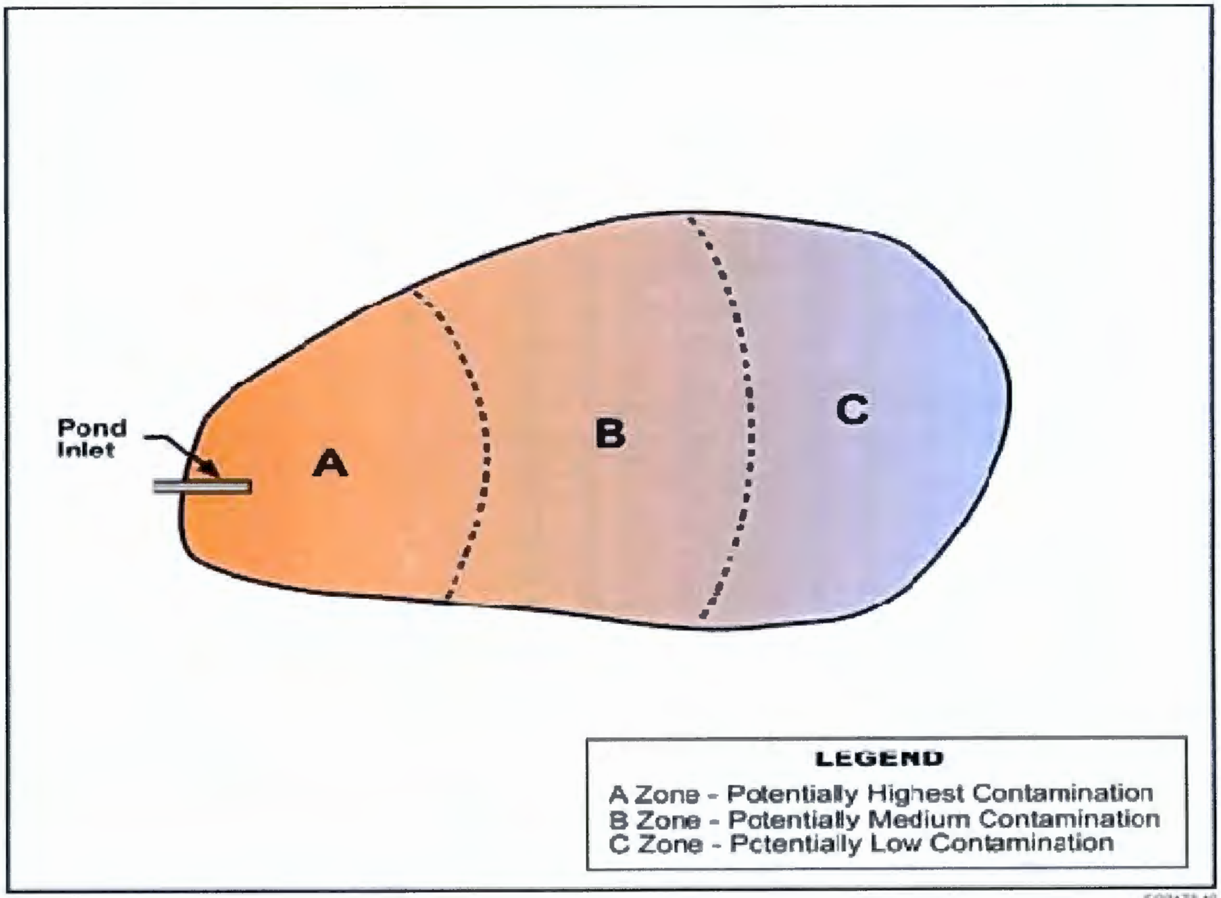

Figure A-2. Planned Geophysical Logging Locations at the 216-A-25 Pond.

See Table A-16 for sample details.

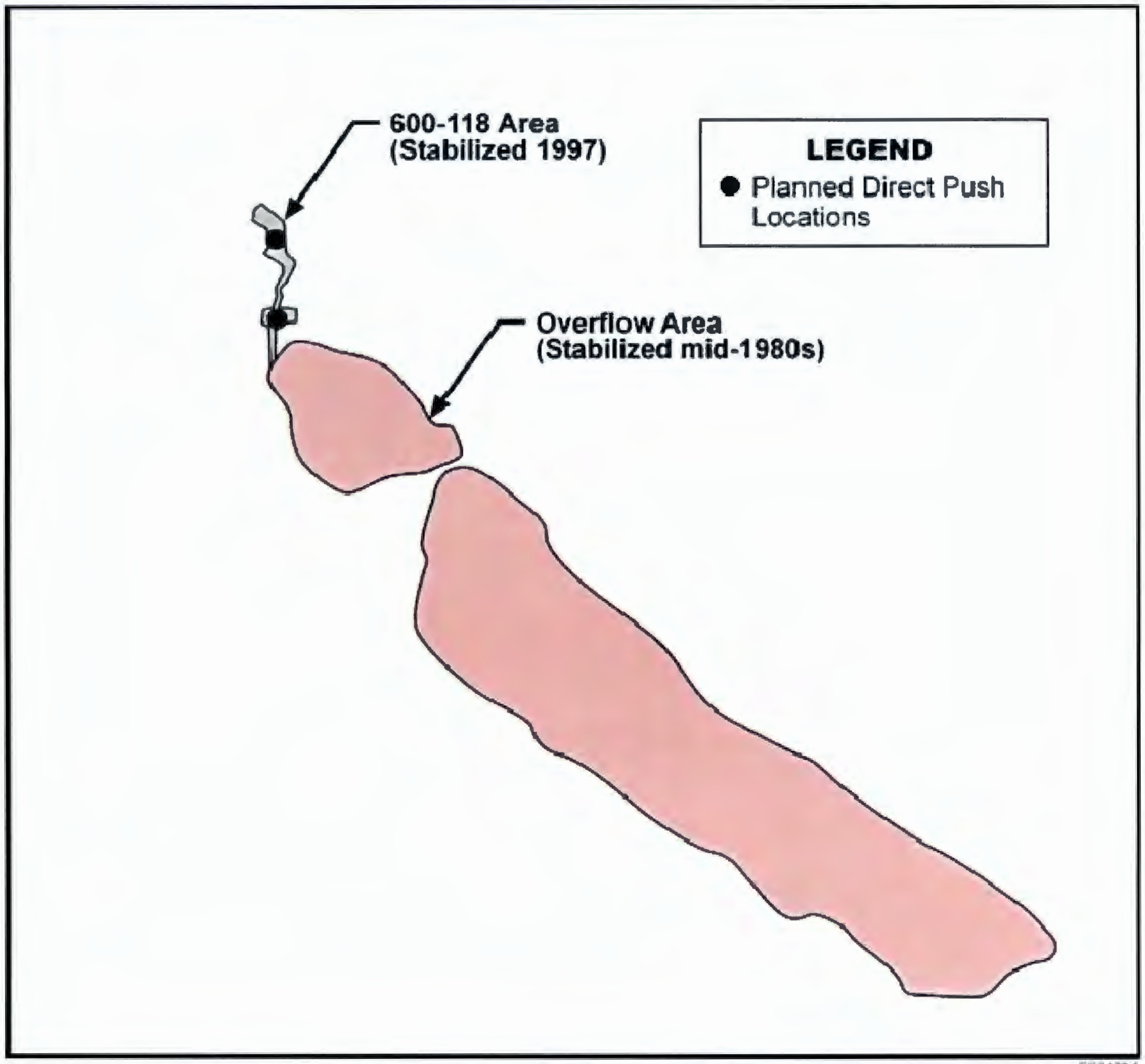

Figure A-3. Planned Geophysical Logging Locations at the B Pond.

See Table A-16 for sample details.

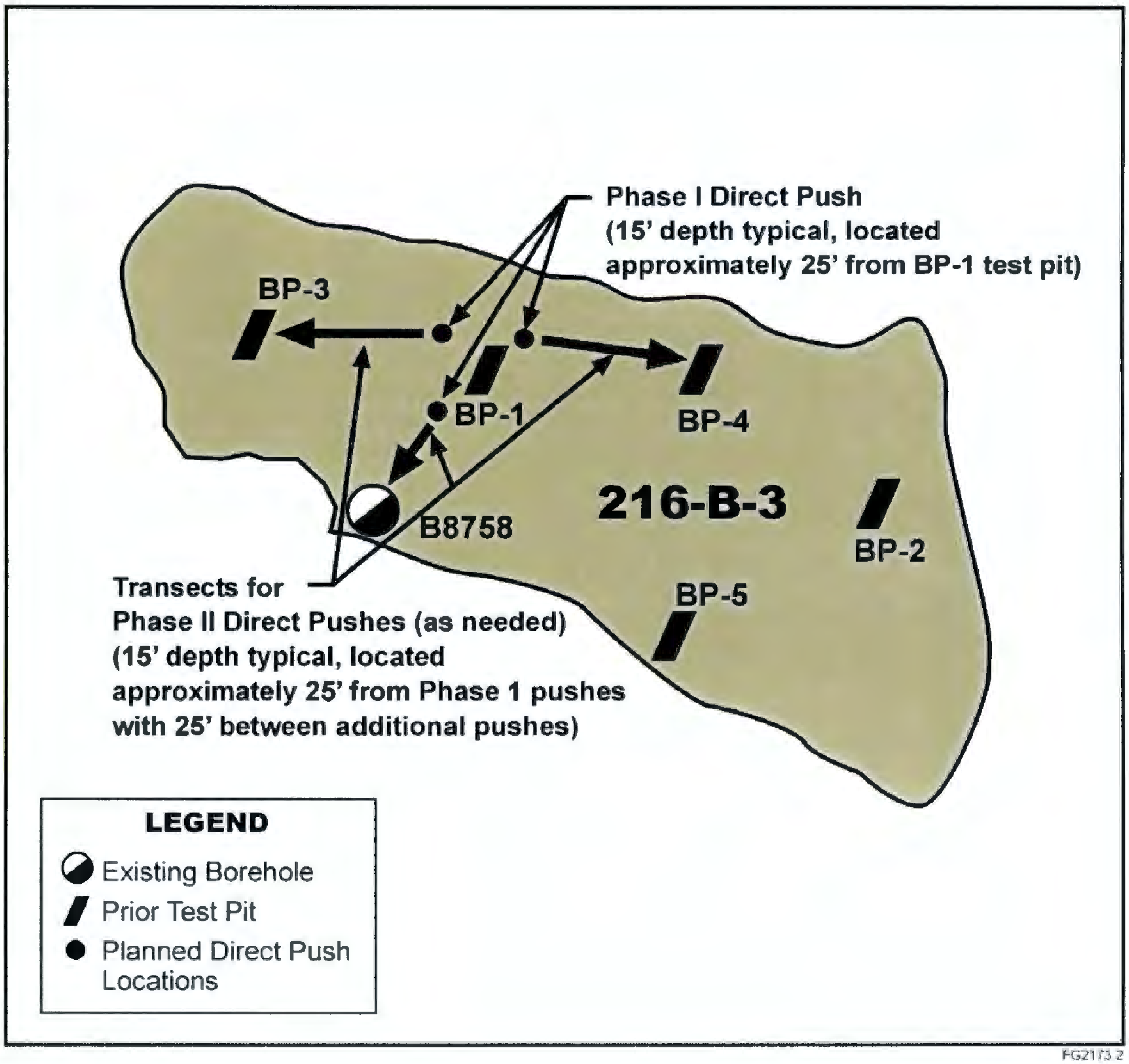

Figure A-4. Planned Geophysical Logging Locations at the 216-S-16 Pond.

See Table A-16 for sample details.

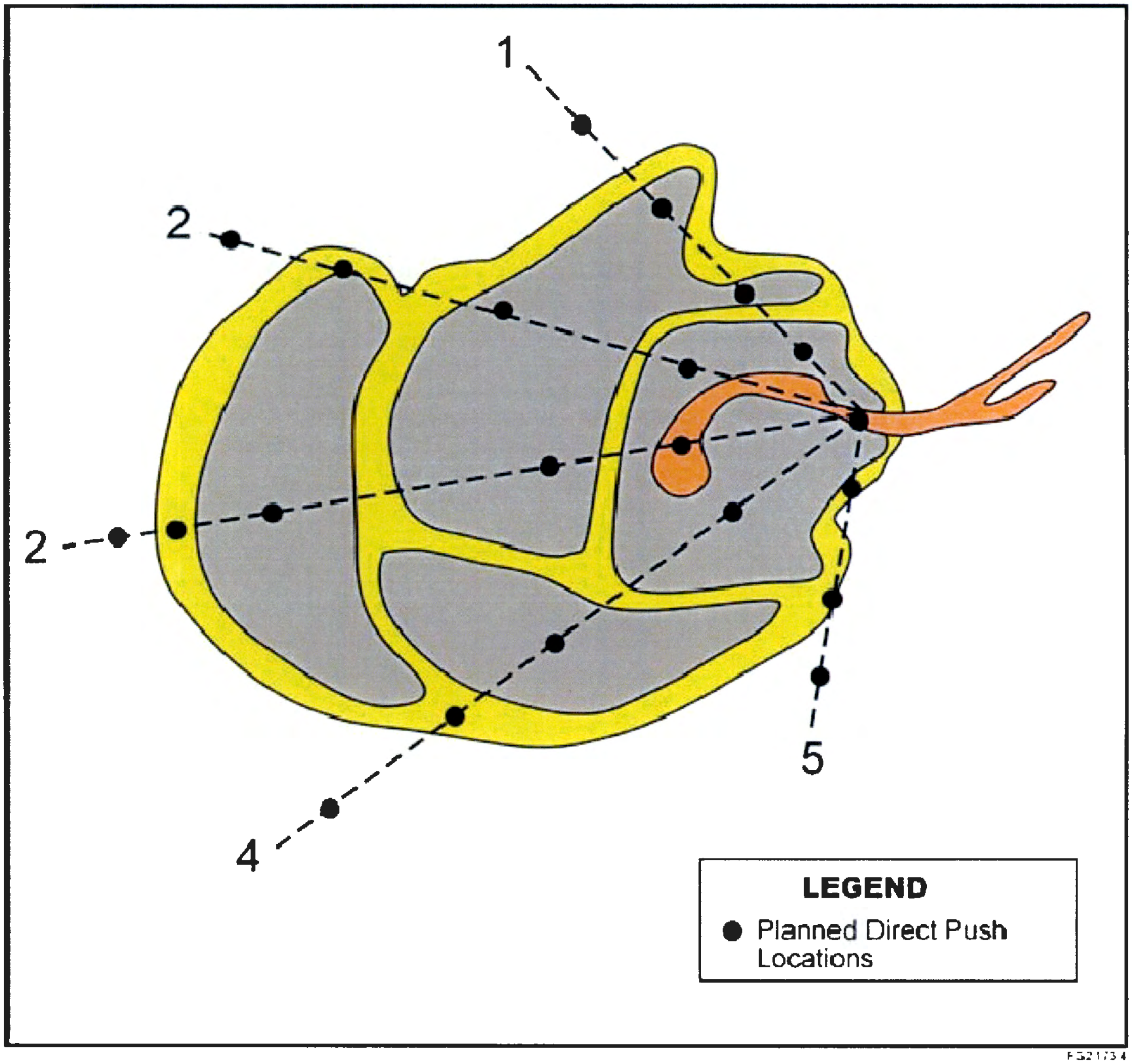

Figure A-5. Planned Geophysical Logging Locations at the 216-S-17 Pond.

See Table A-16 for sample details.

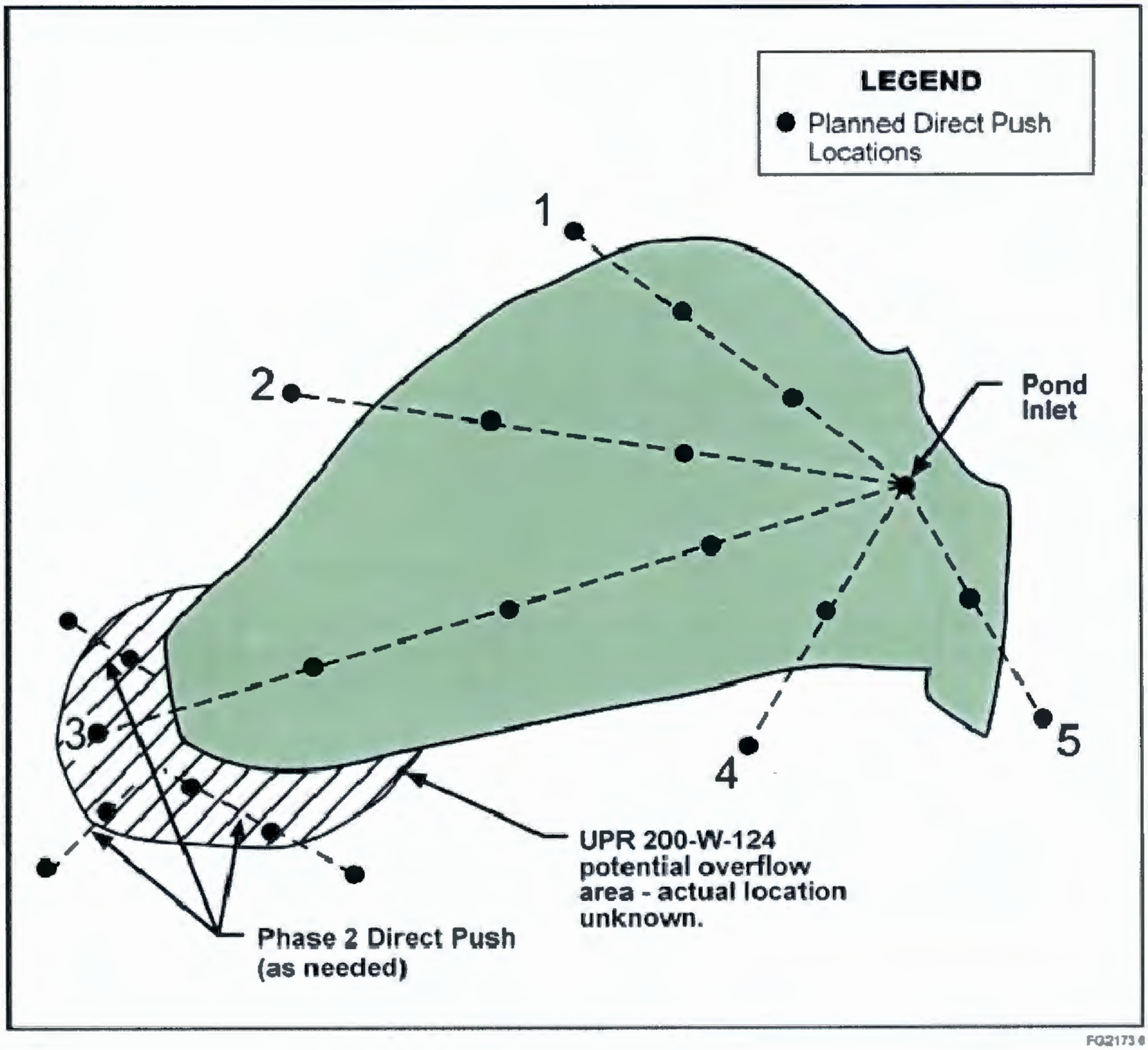

Figure A-6. Planned Geophysical Logging Locations at the 216-T-4B Pond.

See Table A-16 for sample details.

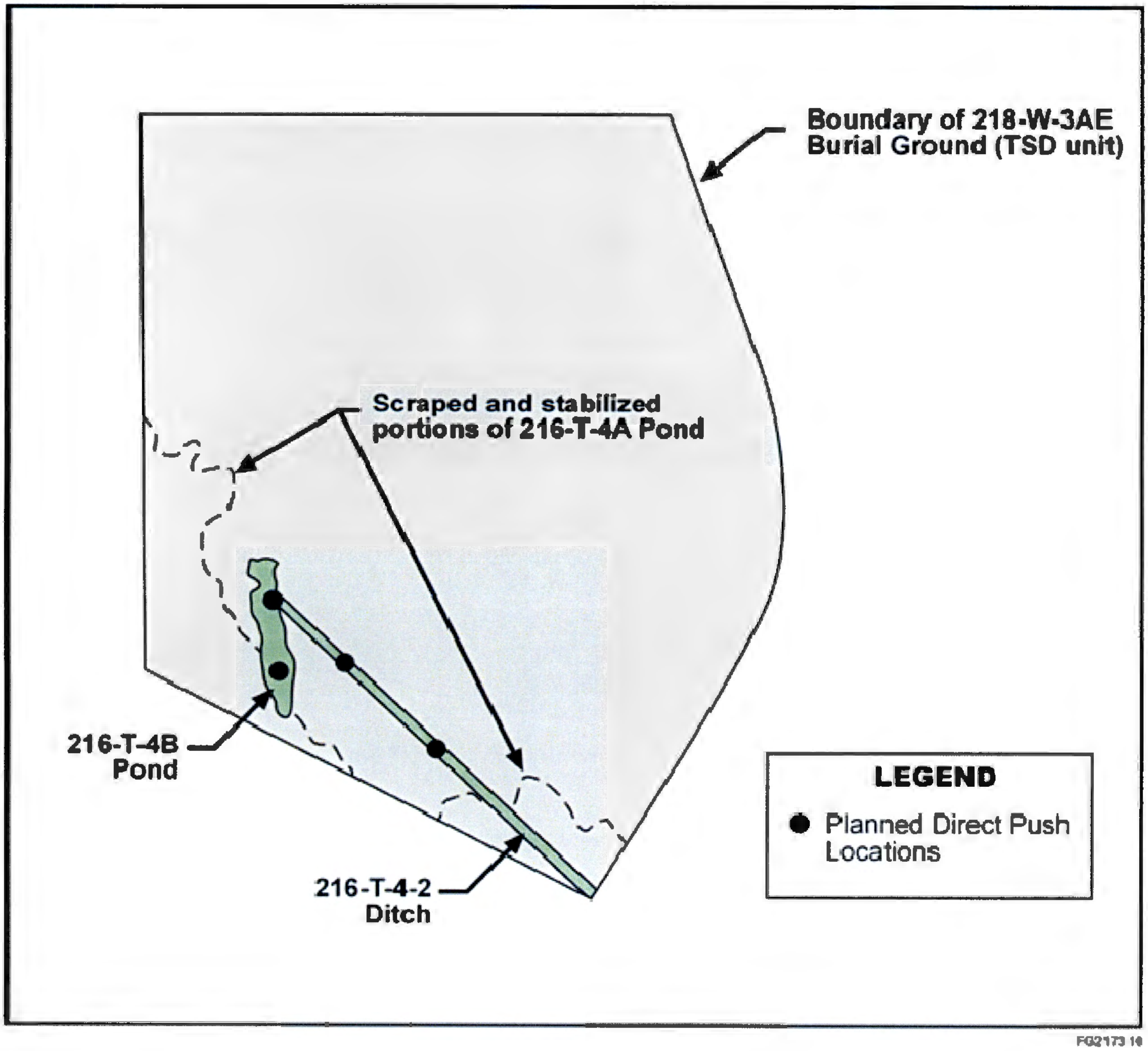

Figure A-7. Planned Data Collection Locations at the 216-U-10 Pond.

See Table A-16 for sample details.

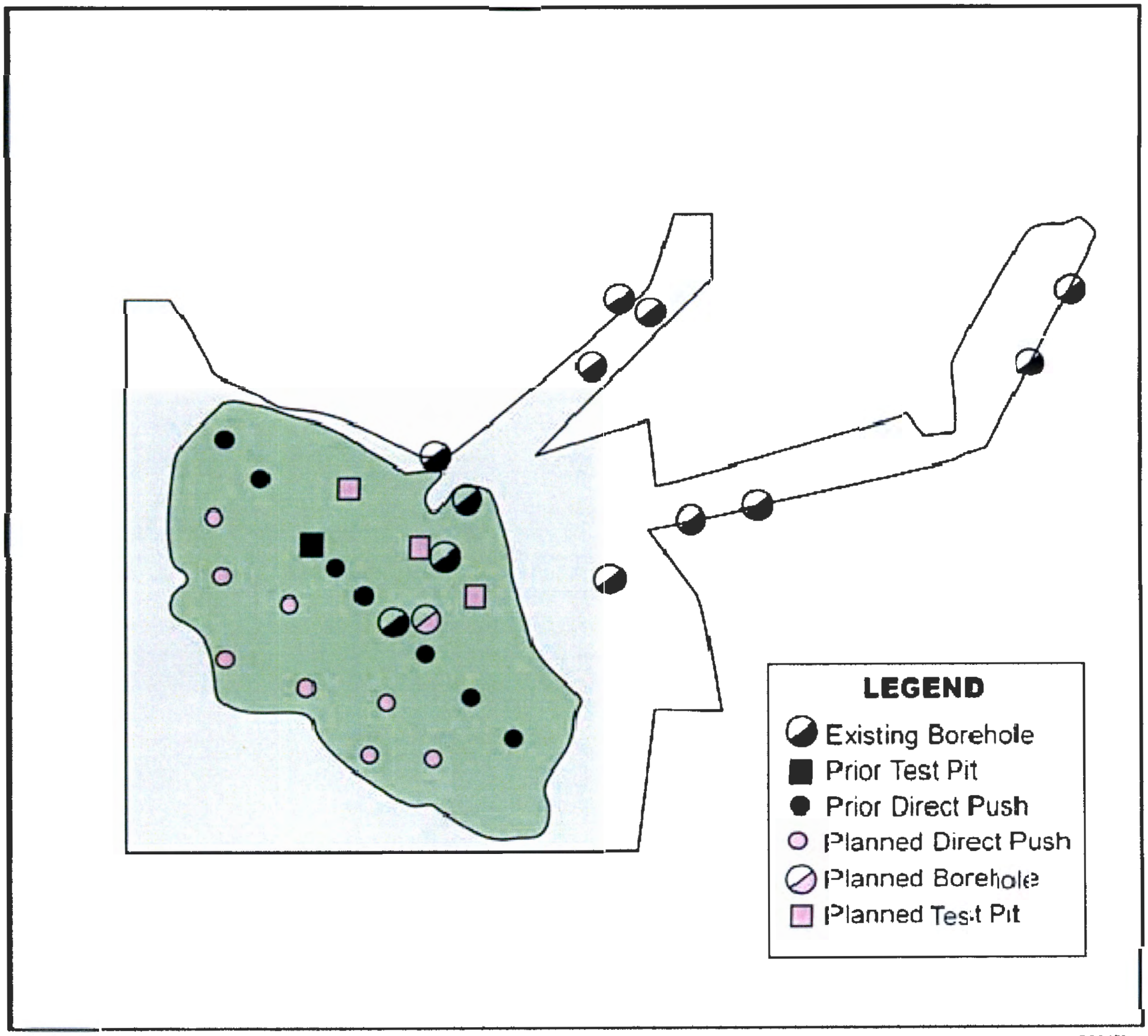

Figure A-8. 216-U-10 Pond Stratigraphy Column.

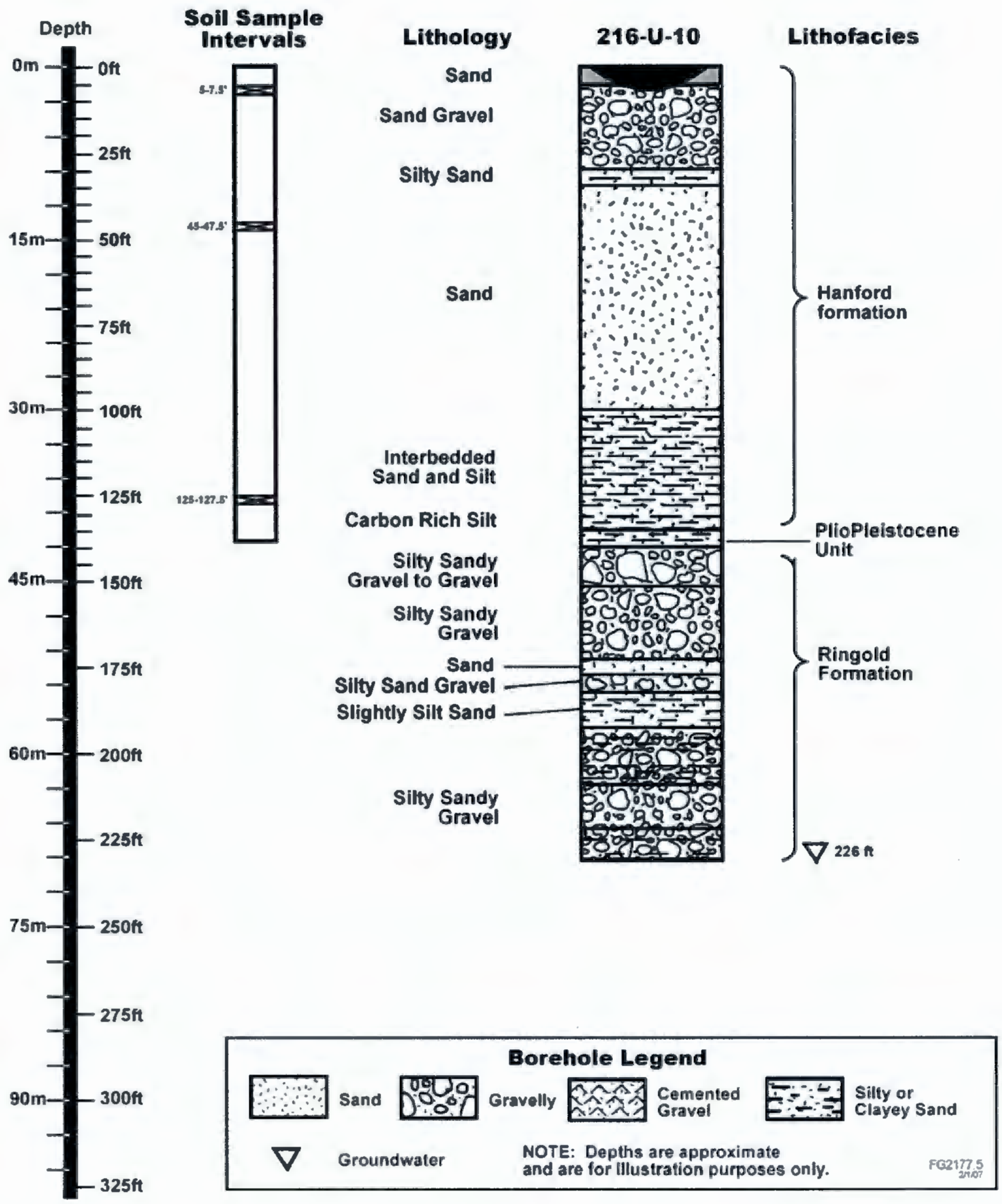

Figure A-9. Planned Geophysical Logging Locations at the 216-U-11 Ditch.

See Table A-16 for sample details.

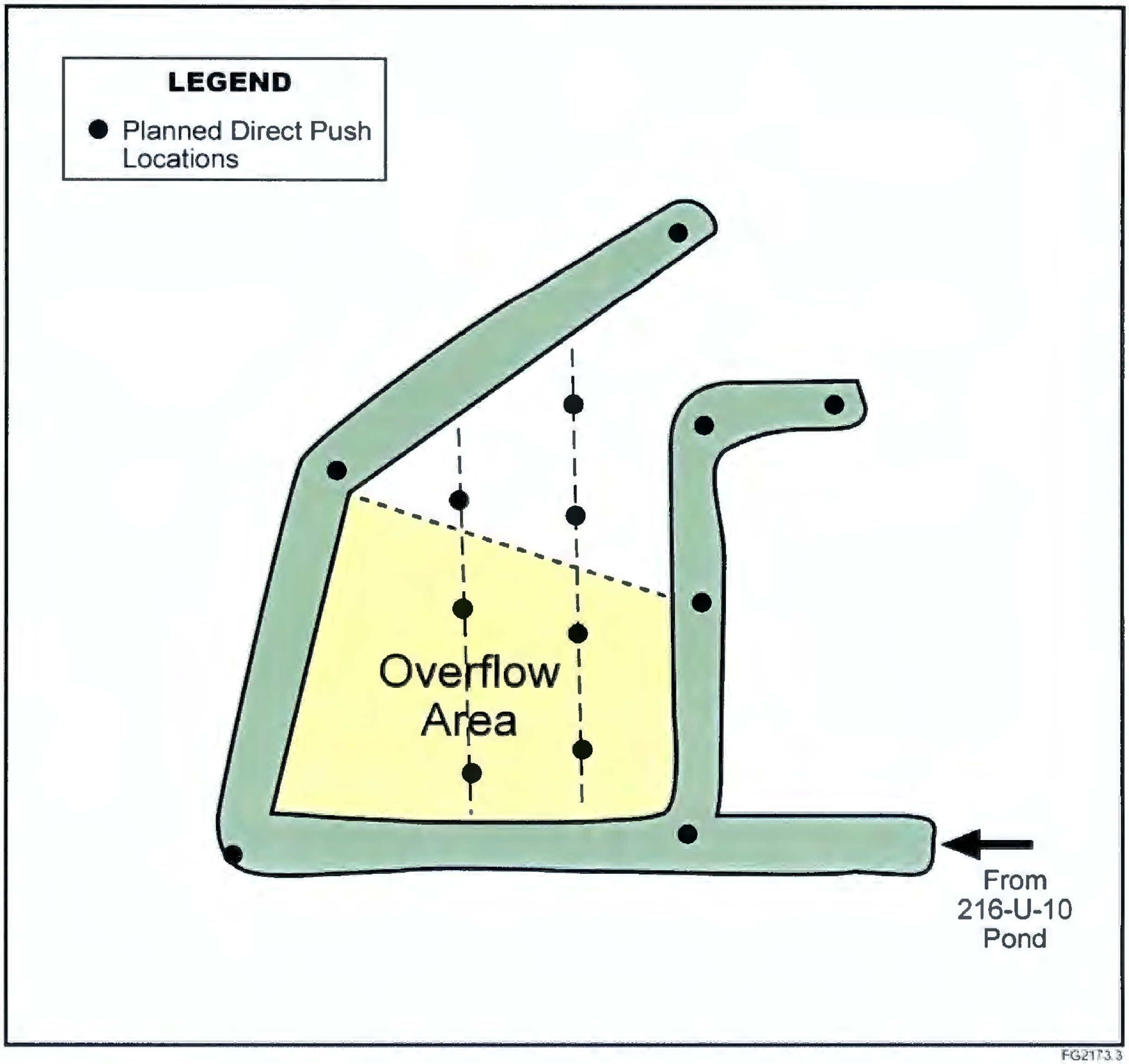

Table A-1. Potentially Applicable or Relevant and Appropriate Requirements. (2 Pages)

Depth Interval For Compliance	Potential Applicable or Relevant and Appropriate Requirements	Action Levels
Radionuclides Inside the 200 Area Land-Use Boundary (Industrial Land Use) [a]		
Shallow zone (0 to 4.6 m [0 to 15 ft] bgs)	Human health; 10^{-4} to 10^{-6} risk range per CERCLA in 40 CFR 300, interpreted by EPA as 15 mrem/yr above background; OSWER 9200.4-18 (TBC) guidance on cleanup levels.	Contaminant-specific; RESRAD modeling [b]
	Ecological – ANL, 2006, *RESRAD-BIOTA*, Version 1.2 Software	
Deep zone (ground surface to groundwater)	4 mrem/yr above background to groundwater, or no additional groundwater degradation.	Maximum contamination levels, State and Federal ambient water quality control criteria; alternatively, site-specific modeling using STOMP model
Nonradiological Constituents Inside the 200 Area Land-Use Boundary (Industrial Land Use) [a]		
Shallow zone (0 to 4.6 m [0 to 15 ft] bgs)	Human health - WAC 173-340-745(5) Method C	Chemical specific (with contaminant-specific variations)
	Ecological – WAC 173-340-7493 (WAC 173-340-900, Table 749-3)	Chemical specific
Deep zone (ground surface to groundwater)	WAC 173-340-747(4) Method B criteria	Fixed-parameter three-phase partitioning model (Equation 747-1); alternatively, site-specific modeling using STOMP model
Radionuclides Outside the 200 Area Land-Use Boundary (Conservation [Mining]) [a]		
Shallow zone (0 to 4.6 m [0 to 15 ft] bgs)	Human health; 10^{-4} to 10^{-6} risk range per CERCLA in 40 CFR 300, interpreted by EPA as 15 mrem/yr above background; OSWER 9200.4-18 (TBC) guidance on cleanup levels.	Contaminant-specific; RESRAD modeling [b]
	Ecological – ANL, 2006, *RESRAD-BIOTA*, Version 1.2 Software	
Deep zone (ground surface to groundwater)	4 mrem/yr above background to groundwater, or no additional groundwater degradation.	Maximum contamination levels, State and Federal ambient water quality control criteria; alternatively, site-specific modeling using STOMP model
Nonradiological Constituents Outside the 200 Area Land-Use Boundary (Conservation [Mining]) [a]		
Shallow zone (0 to 4.6 m [0 to 15 ft] bgs)	Human health - WAC 173-340-740(3) Method B	Chemical specific (with contaminant-specific variations)
	Ecological – WAC 173-340-7493 (WAC 173-340-900, Table 749-3)	Chemical specific
Deep zone (ground surface to groundwater)	WAC 173-340-747(4) Method B criteria	Fixed-parameter three-phase partitioning model (Equation 747-1); alternatively, site-specific modeling using STOMP model

[a] DOE/EIS-0222-F, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement*, as modified by the risk framework. Waste sites near the fringe of the Core Zone Boundary may be subject to a residential use scenario.

[b] The RESidual RADioactivity dose model (RESRAD) (ANL, 2002, *RESRAD for Windows*, Version 6.21) has been used for similar waste sites and will be used as a minimum for direct exposure. If more appropriate models are developed, they will be evaluated for use.

40 CFR 300 = "National Oil and Hazardous Substances Pollution Contingency Plan."
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980.*
OSWER 9200.4-18 = EPA, 1997, *Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination.*
RESRAD-BIOTA = ANL, 2006, *RESRAD-BIOTA*, Version 1.2 Software.
STOMP = PNNL-12028, *STOMP Subsurface Transport Over Multiple Phases, Version 2.0, Application Guide.*

Table A-1. Potentially Applicable or Relevant and Appropriate Requirements. (2 Pages)

Depth Interval For Compliance	Potential Applicable or Relevant and Appropriate Requirements	Action Levels

WAC 173-340-740(3) Method B = "Unrestricted Land Use Soil Cleanup Standards," "Method B Soil Cleanup Levels for Unrestricted Land Use."
WAC 173-340-745(5) Method C = "Soil Cleanup Standards for Industrial Properties," "Method C Industrial Soil Cleanup Levels."
WAC 173-340-747(4) Method B criteria = "Deriving Soil Concentrations for Ground Water Protection," "Fixed Parameter Three-Phase Partitioning Model."
WAC 173-340-900, "Tables."
WAC 173-340-7493 = "Site-Specific Terrestrial Ecological Evaluation Procedures."
bgs = below ground surface.
EPA = U.S. Environmental Protection Agency..
TBC = to be considered.

Table A-2. Summary of Data Quality Objectives Step 2 Information.

PSQ-AA #	Alternative Action	Consequences of Erroneous Actions	Severity of Consequences
Principal Study Question #1—Do the radionuclide concentrations in vadose-zone soils associated with large cooling-water pond waste sites exceed the annual radiological exposure limits for human health, groundwater, and ecological protection under residential and/or industrial exposure scenarios? [a]			
1-1	If the radionuclide concentrations in the vadose-zone soils do not exceed the identified exposure limits, evaluate the site for closeout with no remedial action in an FS.	The site may be inappropriately closed without remedial action, increasing risks of potential exposure to workers and the environment.	Moderate, because the pond waste sites are not highly contaminated.
1-2	If the radionuclide concentrations in the vadose-zone soils exceed the identified exposure limits, evaluate the need for remedial-action alternatives or evaluate a streamlined approach to site closeout (e.g., add to an existing ROD) in an FS.	The site may be inappropriately remediated, resulting in unnecessary expenditure of funds.	Low
Decision Statement #1—Determine if the vadose-one radionuclide concentrations associated with large cooling-water pond waste sites exceed the radiological exposure limits for human health, groundwater, and ecological protection under residential and/or industrial exposure scenarios, and select an appropriate alternative action.			
Principal Study Question #2—Do the concentrations of nonradiological constituents in the vadose-zone soils associated with large cooling-water pond waste sites exceed the nonradiological exposure limits for human health, groundwater, and ecological protection under residential and/or industrial exposure scenarios? [a]			
2-1	If the nonradiological constituent concentrations in the vadose-zone soils do not exceed the identified exposure limits, evaluate the site for closeout with no remedial action in an FS.	The site may be inappropriately closed without remedial action, increasing risks of potential exposure to workers and the environment.	Moderate, because the pond waste sites are not highly contaminated.
2-2	If the nonradiological constituent concentrations in the vadose-zone soils exceed the identified exposure limits, evaluate the need for remedial-action alternatives or evaluate a streamlined approach to site closeout (e.g., add to an existing ROD) in an FS.	The site may be inappropriately remediated, resulting in unnecessary expenditure of funds.	Low
Decision Statement #2—Determine if vadose-zone nonradiological constituent concentrations associated with large cooling-water pond waste sites exceed the nonradiological constituent exposure limits for human health, groundwater, and ecological protection under residential and/or industrial exposure scenarios, and select an appropriate alternative action.			

[a] Refer to Table A-1 for potential applicable or relevant and appropriate requirements.

AA = alternative action.
FS = feasibility study.
PSQ = principal study question.
ROD = record of decision.

Table A-3. Required Information and Reference Sources.

PSQ # / PS	Required Information Category	Reference Source	Are Additional Data Required to Support RI/FS Process? [Yes [a] /No]											
			216-A-25	216-B-3	216-B-3A	216-B-3B	216-B-3C	216-S-10	216-S-16	216-S-17	UPR-200-W-124	216-T-4B	216-U-10	216-U-11
1	Soil radiological data	See the following discussion for information used to formulate table responses.	Y	Y	N[b]	N[b]	N[b]	N	Y	Y	TBD	Y	Y	Y
2	Soil non-radiological sample data	See the following discussion for information used to formulate table responses.	N	Y	N	N	N	N	Y	Y	N	Y	Y	N
PS	Physical properties moisture content, particle size distribution, and lithology	*Hydrogeologic Model for the 200-East Groundwater Aggregate Area,* WHC-SD-EN-TI-019, Rev. 0. Presents site-specific data for 200 East Area that can be used to calculate soil density, hydraulic conductivity, and porosity.	N	N[c]	N	N	N	-	-	-	-	-	-	-
		Hydrogeologic Model for the 200-West Groundwater Aggregate Area, WHC-SD-EN-TI-014, Rev. 0. Presents site-specific data for 200 West Area that can be used to calculate soil density, hydraulic conductivity, and porosity.	-	-	-	-	-	N	N[d]	N[d]	N	N	N	N

[a] Yes responses mean that more data will be collected.
[b] Radiological data are sufficient based on further evaluation of radiological sample analysis indicating that the analysis met detection limits.
[c] This unplanned release is contiguous with the 216-S-17 Pond; unplanned release characterization will be coordinated with 216-S-17 Pond data collection, and the need to collect UPR data will be determined by the results of the 216-S-17 Pond characterization.
[d] Analysis of soil samples for physical properties will be required, if soil sampling is indicated by geophysical logging and if physical property data do not exist.

N/A = not applicable.
PS = problem statement.
PSQ = principal study question.
RI/FS = remedial investigation/feasibility study.

Table A-4. Information Required to Resolve the Decision Statements.

DS #	Remedial Investigation Variable	Required Data	Computational Methods	Survey/Analytical Methods
1	Concentrations of radiological COPCs in vadose-zone soils	Alpha, beta, and gamma COPC concentrations in soils for evaluation against ARARs and PRGs. Location data (e.g., vertical and lateral extent of COPCs within waste-site boundaries).	RESRAD – analytical modeling method for human-health dose assessment. STOMP or other analytical code – analytical modeling through the vadose zone to groundwater.	Field screening with radiological detection equipment. Geophysical logging with downhole radiological detectors. Soil sampling and laboratory analysis.
2	Concentrations of nonradiological COPCs in vadose-zone soils	Nonradiological (e.g., inorganic metals, anions, and SVOCs) COPC concentrations in soils for evaluation against potential ARARs. Location data (e.g., vertical and lateral extent of COPCs within waste-site boundaries).	WAC 173-340-745, WAC 173-340-747 Risk assessment STOMP or other analytical code – analytical modeling through vadose zone to groundwater.	Field screening. Soil sampling and laboratory analysis.
Objective	Physical properties in vadose-zone soils in support of the preliminary conceptual contaminant distribution model(s) [a]	K_d and leachability (if boreholes required).	N/A	N/A

[a] Physical property data will only be considered for deeper borehole soils.
WAC 173-340-745, "Soil Cleanup Standards for Industrial Properties."
WAC 173-340-747, "Deriving Soil Concentrations for Ground Water Protection."

ARAR = applicable or relevant and appropriate requirement.
COPC = contaminant of potential concern
DS = decision statement.
K_d = distribution coefficient.
N/A = not applicable.
PRG = preliminary remediation goal.
RESRAD = RESidual RADioactivity (dose model) (ANL 2002)
STOMP = Subsurface Transport Over Multiple Phases (PNNL-12028)
SVOC = semivolatile organic compound.

Table A-5. Potentially Appropriate Survey and/or Analytical Methods. (2 Pages)

Media	Remediation Variable	Potentially Appropriate Survey/ Analytical Method	Possible Limitations
Field Screening			
Fine-grained materials, structures	Site location; underground structures or interferences	Ground-penetrating radar (GPR)	GPR is a radar-reflection surface geophysical survey technique that detects contrasts in di-electric constants in the below-grade environments from the surface. It requires subjective interpretation of the reflected signals. Lack of reflective below-grade surfaces or the presence of interfering matrices can complicate or invalidate the findings. The presence of nearby buildings and utilities can interfere with reflected signals. Fines (e.g., clay, heavy fly ash) can act as a reflector to the radar signal.
		Electromagnetic imaging (EMI)	EMI is a surface geophysical survey technique that measures electrical conductivity in below-grade soils, based on detected changes in electrical fields. The results of EMI generally are used to support the interpretation of GPR surveys. Nearby buildings and utilities can cause interferences. Setup can be complex, because it requires correlation with potential contaminants to effectively identify contaminants, but it is considered effective in identifying nitrates, a common waste site contaminant, and may be effective for other anions as well.
Vadose-zone soils	Vertical moisture profile	High-resolution resistivity (HRR)	HRR is a surface geophysical survey technique that measures conductivity in below-grade soils (via electrodes) to detect moisture plumes that contain nitrate or other anionic contamination. The resulting plume maps predict the presence of subsurface moisture plumes. This fast and inexpensive technique gives preliminary indication of potential groundwater contamination problems. It requires correlation with the potential contaminant
	Gross and isotopic gamma emissions	Cone penetrometer; NaI detector logging	A closed-end rod is pushed into the soil to the desired depth. A small-diameter NaI detector (or other suitable detector) is used to log the gross-gamma response with depth. The cone penetrometer is good to 18.3 m (60 ft) but is not effective in cobbly or rocky soils.
		Direct push; NaI detector logging	A small-diameter casing is pushed into the soil to the desired depth. A small-diameter NaI detector (or other suitable detector) is used to log the gamma response with depth. Direct-push methods (e.g., GeoProbe [a]) may be ineffective in cobbly or rocky soils.
	Gamma emissions from fission products	Borehole spectral-gamma logging (SGL) with high-purity germanium (HPGe) detector	Gamma-ray logging provides the concentration profiles of gamma-emitting radionuclides (primarily fission products) in a borehole environment. It is considered by some to be more accurate than sampling and laboratory assay, because the assay is performed in situ with less disturbance of the sample, there is higher vertical spatial resolution, and the sample size is much larger. This method also may be more economical than traditional sampling and analysis. This method does not assess radionuclides or daughter products that do not emit gamma rays. This technique requires the use of a single casing (installed by drilling or driving) in contact with the soil formation.
	Neutron emissions from plutonium	Cone penetrometer or borehole passive neutron logging	Passive neutron logging provides indication of the presence of neutron-emitting isotopes. Because of the very low incidence of spontaneous plutonium fission and alpha-N reactions, the passive neutron profile is orders of magnitude lower than the gamma emissions. Effective detection in the down-hole environment begins near the transuranic concentration threshold (not expected at pond waste sites).

Table A-5. Potentially Appropriate Survey and/or Analytical Methods. (2 Pages)

Media	Remediation Variable	Potentially Appropriate Survey/ Analytical Method	Possible Limitations
Vadose-zone soils (cont)	Active neutron emissions from transuranics	Borehole passive/active neutron-logging methods	This technique uses source materials or generators to release neutrons into the soil formation. Passive detectors measure the response to the neutron flux as a means of detecting specific transuranic constituents. Although neutron activation methods have been developed, they are not expected to be useful for this initial characterization. At present, these techniques are too expensive and time consuming, and logistical problems are associated with the handling of intense sources or generators.
	Vertical moisture profile	Borehole neutron-neutron moisture logging	Neutron-neutron moisture logs can be used to determine current moisture content profiles of the subsurface through new or existing boreholes. The moisture profiles often are directly correlated to contaminant concentrations, sediment grain size, composition, or subsurface structural features. For this project, the moisture profile may be useful for helping to determine the location of contamination and establish geologic conditions to support contaminant fate and transport modeling. It also may be correlated to reflections identified in ground-probing radar surveys.
Laboratory Samples			
Vadose-zone soils	All COPCs and physical properties	Laboratory analysis	

[a] GeoProbe is a registered trademark of GeoProbe Systems, Salinas, Kansas.

COPC = contaminant of potential concern.
EMI = electromagnetic imaging.
GPR = ground-penetrating radar.
HPGe = high-purity germanium.
HRR = high-resolution resistivity.
NaI = sodium iodide.
SGL = spectral-gamma logging.

Table A-6. Characteristics that Define the Population of Interest.

DS #	Population of Interest	Characteristics
All	Contaminated vadose-zone soils in the large-area pond sites	The contaminated vadose-zone soils may contain concentrations of radionuclides, metals, and/or organic constituents above human health, ecological, and/or groundwater protection action levels.

DS = decision statement.

Table A-7. Geographic Boundaries of the Investigation.

DS #	Geographic Boundaries of the Investigation
All	The geographic boundaries for the investigation encompass the largest continuously and intermittently wetted area of the individual large-area pond waste sites. Integration with associated ditches and distribution systems will be considered.

DS = decision statement.

Table A-8. Zones with Homogeneous Characteristics.

DS #	Population of Interest	Zone	Homogeneous Characteristic Logic
All	Contaminated vadose-zone soils in the large-area pond sites	Clean or very low-concentration stabilizing fill over waste site	The pond sites have been stabilized with clean fill that generally is not expected to be contaminated.
		Highest contaminant concentration zone (lateral migration of contaminants) [a]	The particulates and high K_d contaminants were sorbed and/or filtered out of the liquid flow via the soils at the bottom of the pond. This zone is expected to contain the highest concentrations of contaminants and to have decreasing concentrations with depth. It would include areas of localized accumulation. It also may contain residual concentrations of mobile constituents.
		Moderate to low contaminant zone (lateral migration of contaminants)	A moderate concentration layer exists beneath the high-concentration layer. In this zone, finer particulates and moderate K_d contaminants from the liquid-waste streams were filtered and sorbed. High volumes of disposed liquids may have carried some immobile constituents into this zone, and residual concentrations of mobile constituents also may be present. This zone is expected to have decreasing concentrations with depth as more immobile constituents filter and sorb out with the passing of the wetting front.
		Low contaminant concentration zone (lateral migration of contaminants)	This zone is expected to contain low concentrations of the more mobile contaminants. Concentrations are expected to remain fairly constant through this layer to the end of the wetted zone.
		Continuously wetted zone	This zone was continuously wetted during periods of pond operation. Contamination might be expected at higher concentrations and may have been driven deeper. Lower concentrations could be expected where the water moved across the pond.
		Intermittently wetted zone	This zone had fluctuating water levels.
		Vegetation zone (organic mat)	Indications of historical vegetation associated with the pond bottom that could affect contaminant concentrations.
		Topographic zones (contours of the original pond bottom before stabilization)	Indications of differences in topography that could affect contaminant concentrations because of proximity to the pond inlet and waste effluent flow dynamics.
		Soils adjacent to the historical pond boundary	Soils outside the fringe of the historical boundary of the pond that may have been contaminated as a result of lateral migration.

[a] The thickness is not specified.
DS = decision statement.
K_d = distribution coefficient.

Table A-9. Temporal Boundaries of the Decision.

DS #	Timeframe	When to Collect Data
Field Screening		
All	0 – 5 years [a] after issuance of the sampling and analysis plan	No seasonal or process-related limitations.
Laboratory Samples		
All	0 – 5 years [a] after issuance of the sampling and analysis plan	No seasonal or process-related limitations.

[a] Timeframe is approximate and may be impacted by changing priorities, budgets, and approval of the work plan.
DS = decision statement.

Table A-10. Scale of Decision Making.

DS #	Population of Interest	Geographic Boundary	Temporal Boundary		Spatial Scale of Decision Making
			Timeframe [a]	When to Collect Data	
All	Contaminated vadose-zone soils in the large-area pond sites	The geographic boundaries for the investigation are the boundaries of the individual large-area pond waste sites.	0 – 5 years [a] after issuance of the sampling and analysis plan	No seasonal or process-related limits	Vadose-zone soils [b]

[a] Timeframe is approximate and may be impacted by changing priorities, budgets, and approval of the sampling and analysis plan.
[b] Although several zones with homogeneous logic were identified in Table A-8 (e.g., stabilizing fill), they do not determine the spatial scale of decision making for the pond sites.
DS = decision statement.

Table A-11. Constraints on Data Collection.

Practical Constraints	Other Constraints
Boreholes may not obtain sufficient volumes of sample media if the sampled zone is 0.6 m (2 ft) thick or less. Advancement of borehole casing may smear contamination downhole.	Health and safety constraints may be imposed during characterization sampling to ensure that as-low-as-reasonably-achievable issues are properly addressed when radiologically contaminated soils are sampled. Extreme weather conditions may limit or shut down field-screening operations. Cone penetrometer and driven soil-probe applications may be limited in the depth of penetration because of the presence of rock and/or gravel.
The soils in the vadose zone are expected to be typical Hanford Site soils. These soils should be easily recognizable and should not pose unusual sampling problems.	Driven point-probe sampling may not obtain sufficient volumes of sample media if the sampling zone contains gravelly rather than sandy media. Soil matrix characteristics (e.g., gravels) may limit use of chemical field-screen techniques that require fine-grained homogenous materials (e.g., X-ray fluorescence, immunoassay, colorimetric methods). Selection of techniques may minimize impacts on recovering habitat.

Table A-12. Inputs Needed to Develop Decision Rules.

DS #	COPCs	Parameter of Interest	Statistic	Scale of Decision Making	Preliminary Action Levels
1	Radio-nuclides	Mean, maximum, or detected values	95% upper confi-dence limit of the mean, or mean, maximum, or detected values	Shallow vadose-zone soils	*Human health* – Direct radiological exposure dose rate limit of 15 mrem/yr above background. Groundwater radiological exposure dose-rate limit of 4 mrem/yr above background, based on contaminant distribution model and RESRAD (ANL, 2002) modeling.
					Ecological protection – Direct comparison with ecological biota concentration guides per Table A-1.
				Deep vadose-zone soils	*Beta-gamma radionuclides* – Groundwater radiological exposure dose-rate limit of 4 mrem/yr above background, based on site contamination distribution model and RESRAD modeling.
					Sr-90 and tritium radionuclides – Groundwater radiological concentration limits of 8 pCi/L (Sr-90) and 20,000 pCi/L (tritium), or a groundwater radiological exposure dose-rate limit of 4 mrem/yr above background, based on site contaminant distribution model and RESRAD modeling.
					Alpha-emitting radionuclides – Gross alpha particle activity limit in groundwater of 15 pCi/L, based on site contaminant distribution model and RESRAD modeling.
2	Non-radio-logical consti-tuents			Shallow vadose-zone soils	*Human health* – Shallow zone remedial-action goal [a].
					Ecological protection – Direct comparison with ecological indicator soil concentrations [b].
				Deep vadose-zone soils	*Soil concentrations protective of groundwater* - Deep zone remedial-action goal values [c].

[a] Values calculated using the formulas of WAC 173-340-745(5), "Soil Cleanup Standards for Industrial Properties," "Method C Industrial Soil Cleanup Levels," or WAC 173-340-740(3), "Unrestricted Land Use Soil Cleanup Standards," "Method B Soil Cleanup Levels for Unrestricted Land Use," from Ecology 94-145, *Cleanup Levels and Risk Calculations under the Model Toxics Control Act Cleanup Regulation; CLARC, Version 3.1*, tables, updated November 2001.
[b] Value is the lowest concentration for each analyte (adjusted for background) calculated in accordance with WAC 173-340-7493, "Site-Specific Terrestrial Ecological Evaluation Procedures," requirements from Tables 749-2 and 749-3 of WAC 173-340-900, "Tables," amended February 12, 2001.
[c] Calculated using WAC 173-340, "Model Toxics Control Act -- Cleanup," WAC 173-340-747(4), "Deriving Soil Concentrations for Ground Water Protection," "Fixed Parameter Three-Phase Partitioning Model."
ANL, 2002, *RESRAD for Windows*, Version 6.21.

COPC = contaminant of potential concern.
DS = decision statement.
RESRAD = RESidual RADioactivity (dose model) (ANL, 2002).

Table A-13. Radionuclide Constituents of Potential Concern – Shallow- and Deep-Zone Soils.

Contaminants of Potential Concern	Chemical Abstracts Service #	Preliminary Action Level [a]			
		Human Health (15 mrem/yr [b])		Ecological Protection (pCi/g)	Groundwater Protection [c] (pCi/g)
		Industrial (pCi/g)	Unrestricted (pCi/g)		
Americium-241	14596-10-2	335	31.0	3,890	N/A
Cesium-137	10045-97-3	23.4	6.2	20.8	N/A
Europium-154	15585-10-1	10.3	3.0	1290	N/A
Neptunium-237	13994-20-2	59.2	2.44	1900	N/A
Plutonium-239/240	Pu-239/240	425	33.9	6,110	N/A
Strontium-90	Rad-Sr	2,410	3.8	22.5	N/A
Technetium-99	14133-76-7	412,000	8.5	4490	171
Uranium-238	U-238	504	90.0 or .61	1,580	38.1

[a] The preliminary action level is the regulatory or risk-based value used to determine appropriate analytical requirements (e.g., detection limits). Remedial action levels will be proposed in the feasibility study, will be finalized in the record of decision, and will drive remediation of the sites.

[b] 15 mrem/yr = nonradiological worker industrial exposure scenario; 2,000 h/yr onsite, 60% indoors, 40% outdoors.. Industrial land-use values generally apply to locations within the industrial exclusive area (Core Zone) and are dependent on the nature and extent of contamination. Unrestricted land-use values that could be applied at some sites outside the industrial-exclusive land-use area are shown.

[c] Groundwater protection radionuclide values are based on either RESRAD or STOMP modeling of drinking water exposure, with the entire vadose zone presumed to be contaminated.

- - = no criteria established
N/A = not applicable.
RESRAD = ANL, 2002, *RESRAD for Windows*, Version 6.21.
STOMP = PNNL-12028, *STOMP Subsurface Transport Over Multiple Phases, Version 2.0, Application Guide.*

Table A-14. Nonradionuclides Constituents of Potential Concern – Shallow- and Deep-Zone Soils. (2 Pages)

Contaminants of Potential Concern	Chemical Abstracts Service #	Preliminary Action Level [a]			
		Direct Contact, WAC 173-340 [b] (mg/kg)		Groundwater Protection [c] (mg/kg)	Terrestrial Biota Protection [d] (mg/kg)
		Method C Industrial	Method B Unrestricted		
Metals					
Antimony	7440-36-0	1,400	32.0	5.4	5
Cadmium	7440-43-9	3,500	80.0	0.81	4
Copper	7440-50-8	130,000	29,600	263	50
Lead	7439-92-1	1,000 [e]	250 [e]	270	50
Manganese	7439-96-5	490,000	11,200	65.3	1100
Mercury	7439-97-6	1,050	24.0	2.09	0.30

Table A-14. Nonradionuclides Constituents of Potential Concern – Shallow- and Deep-Zone Soils. (2 Pages)

Contaminants of Potential Concern	Chemical Abstracts Service #	Preliminary Action Level [a]			
		Direct Contact, WAC 173-340 [b] (mg/kg)		Groundwater Protection [c] (mg/kg)	Terrestrial Biota Protection [d] (mg/kg)
		Method C Industrial	Method B Unrestricted		
Selenium	7782-49-2	17,500	400	5.2	0.30
Silver	7440-22-4	17,500	400	13.6	2
Thallium	7440-28-0	245	5.-6	1.59	1.0
Uranium (total)	7440-61-1	10,500	240	1.32	5
Inorganics					
Cyanide	57-12-5	70,000	1600	0.80	N/A
Fluoride	16984-48-8	210,000	4800	16	N/A
Nitrate	14797-55-8	Unlimited	128,000	40	N/A
Organics					
Toluene	108-88-3	70,000	16,000	11.6	200

[a] The preliminary action level is established during the data quality objectives process and is the regulatory or risk-based value used to determine appropriate analytical requirements (e.g., detection limits). Remedial action levels will be proposed in the feasibility study, will be finalized in the record of decision, and will drive remediation of the sites.

[b] WAC 173-340-745(5), "Soil Cleanup Standards for Industrial Properties," "Method C Industrial Soil Cleanup Levels," or WAC 173-340-740(3), "Unrestricted Land Use Soil Cleanup Standards," "Method B Soil Cleanup Levels for Unrestricted Land Use," values for direct exposure from Ecology 94-145, *Cleanup Levels and Risk Calculations under the Model Toxics Control Act Cleanup Regulation; CLARC, Version 3.1*, tables, updated November 2001.

[c] Calculated using WAC 173-340-747(4), "Deriving Soil Concentrations for Ground Water Protection," "Fixed Parameter Three-Phase Partitioning Model."

[d] Value is the lowest concentration for each analyte (adjusted for background) from Tables 749-2 and 749-3 of WAC 173-340-900, "Tables," amended February 12, 2001.

[e] Based on WAC 173-340-740(2), "Unrestricted Land Use Soil Cleanup Standards," "Method A Soil Cleanup Levels for Unrestricted Land Use," values from Table 740-1 in WAC 173-340-900, and on WAC 173-340-745(3), "Soil Cleanup Standards for Industrial Properties," "Method A Industrial Soil Cleanup Levels," values from Table 745-1 in WAC 173-340-900.

Table A-15. Decision Rules.

DR #	Decision Rule
1	If the activity of radionuclides (as estimated by the 95 percent upper confidence limit of the mean, or mean, maximum, or detected values) in large-area pond vadose-zone soils results in a direct radiological exposure dose rate that exceeds the human health, groundwater, and/or ecological protection preliminary action levels for rural/residential (unrestricted surface use outside the core zone) and/or industrial (waste management) exposure scenarios, based on the site contaminant distribution model and RESRAD (ANL, 2002) modeling (Table A-12), select an appropriate action from Table A-2.
2	If the concentrations of nonradiological constituents (as estimated by the 95 percent upper confidence limit of the mean, or mean, maximum, or detected values) in large-area pond vadose-zone soils exceed the preliminary action levels for human health, groundwater, and/or ecological protection for rural/residential (unrestricted surface use outside the core zone) and/or industrial (waste management) exposure scenarios (Table A-12), select an appropriate action from Table A-2.

DR = decision rule.
RESDRAD = RESidual RADioactivity (dose model) (ANL, 2002, *RESRAD for Windows*, Version 6.21).

Table A-16. Key Features of Model Group 5, Ponds, Sampling Design. (8 Pages)

Survey or Analytical Methodology	Key Features of Design	Sampling Design Rationale
216-A-25 Gable Mountain Pond		
Geophysical Logging – Direct Push and Small-Diameter Spectral-Gamma Logging Tool	*Medium*: Soil *Specific Location/Area of Concern*: Determine general extent of contamination at this stabilized, secondary overflow area emanating from the northwest corner of the stabilized, primary overflow section (Figure A-2). *Investigation Method*: Install two (2) direct-push probes to a depth of 6 m (20 ft). The pushes will be located generally as shown on Figure A-2, based on the highest concentration areas identified by surface radiation surveys as guided by prior flyover reports. Probes will be geophysically logged using small-diameter spectral-gamma logging instruments. *Parameter*: Spectral gamma determined by Cs-137 activity above the logging action level [c]. *Sample(s)*: None considered required or currently planned.	This overflow area was only intermittently wetted and is not reasonably considered to be contaminated at levels above the primary, continually wetted, area that does not require sampling. This location includes hot spots shown by the last flyover (1996) that were stabilized in 1997 with 45.7 to 61 cm (18 to 24-in.) of rock and soil (BHI-01133). However, given that this site is located outside of the industrial-exclusive land use area, sensitivity exists to other, nonindustrial land uses and potential exposure scenarios. Supplemental data would be helpful in confirming that concentrations in this overflow area are consistent with the primary pond overflow location from which it emanates.

Table A-16. Key Features of Model Group 5, Ponds, Sampling Design. (8 Pages)

Survey or Analytical Methodology	Key Features of Design	Sampling Design Rationale
B Pond		
Geophysical Logging – Direct Push and Small-Diameter Spectral-Gamma Logging Tool	*Medium*: Soil *Specific Location/Area of Concern*: Lateral extent of contamination around BP-1 Test Pit in the 216-B-3 Main Pond. No investigation is planned for the B Pond Lobes. *Investigation Method*: 3-phased investigation approach: **Phase 1**: Three direct pushes will be driven into pond soil surrounding the BP-1 Test-Pit hot spot (see Figure A-3). One probe will be placed along each of 3 transects between the BP-1 Test-Pit location and Test-Pit BP-3, Test-Pit BP-4, and Borehole B8758. One probe will be driven approximately 7.6 m (25 ft) away from the BP-1 Test Pit along each transect to a depth of approximately 4.6 m (15 ft) below ground surface (bgs). The probes will be logged using small-diameter spectral-gamma instruments capable of detecting Cs-137 concentrations to 1 pCi/g. If logging results at a probe are below the logging action level for Cs-137 [c] no further investigation will be conducted at B Pond. **Phase 2** will occur if spectral gamma, detected at probe location(s), exceeds the logging action level for Cs-137. Continue probe installation <u>outward</u> from the first probe location along the same transect and depth using a 7.6 m (25-ft) interval between probes, until a concentration equal to or less than the logging action level for Cs-137 is reached and the area of elevated contamination is delineated. **Phase 3** will occur if less than the logging action level for Cs-137 is detected at a probe location: Continue probe installation <u>inward</u> from the last probe along the same transect at half the distance between the last probe and the prior probe or the BP-1 Test Pit to refine extent of contamination.	200-CW-1 Remedial Investigation results in DOE/RL-2000-35 indicated that the BP-1 Test Pit had the highest concentrations of contaminants, including Cs-137. Use Cs-137 to determine the extent of contamination radiating out from the BP-1 Test-Pit location. This information could be used to evaluate a partial removal scenario under CERCLA. Four times the action level for Cs-137 (action level for unrestricted use is 6.4 pCi/g) represents the concentration of Cs-137 that would decay within 50 years.
Soil Sampling	*Specific Location/Area of Concern*: Collect one soil sample along the transect with the highest Cs-137 concentration, based on geophysical logging results. Collect the sample at the edge of the area exceeding the Cs-137 logging action level and analyze for RCRA metals and mercury. *Investigation Method*: Sample the soil at the depth of the maximum Cs-137 concentration (corresponding to the bottom of the pond) using the GeoProbe to collect soil. Other field screening techniques, such as hand-held radiation detectors, can be used in conjunction with the above guidance to determine actual sample depths. *Contaminants*: Cadmium, lead, mercury, and Cs-137 [a].	Contamination has been shown through previous sampling to be associated mainly with the pond bottom, approximately 1.8 m (6 ft) bgs. Use soil sampling to determine nonradiological COPC concentrations at the 4 times the Cs-137 extent of the contamination near the BP-1 Test-Pit location.

Table A-16. Key Features of Model Group 5, Ponds, Sampling Design. (8 Pages)

Survey or Analytical Methodology	Key Features of Design	Sampling Design Rationale
216-S-16 Pond		
Geophysical Logging – Direct Push and Small-Diameter Spectral-Gamma Logging Tool	*Medium*: Soil *Specific Location/Area of Concern*: Nature and extent of contamination emanating radially from the pond inlet through the inlet channel and all pond lobes (4). *Investigation Method*: Twenty-one direct pushes will be driven into pond soil beginning at the pond inlet (see Figure A-4). Probes will be placed along 5 transects emanating outward from an existing borehole location in the pond inlet and will intersect all 4 pond lobes. The probes will be placed equidistant along the transects and will be driven approximately 4.6 m (15 ft) deep. The probes will be logged using small-diameter spectral-gamma instruments capable of detecting Cs-137 concentrations to 1 pCi/g. *Parameter*: Spectral gamma determined by Cs-137 activity above the logging action level for Cs-137 [c]. *Evolution(s)*: Locations with significant Cs-137 activity will be sampled.	The pond was approximately 1 m (3 ft) deep during operations. After draining, the pond was stabilized with soil from the dikes. The pond bottom is expected at 1 m (3 ft) bgs. Cs-137 is expected based on discharge information and historical data in the work plan (DOE/RL-99-66). Use Cs-137 for tracking contamination by geophysical logging.
Soil Sampling	*Specific Location/Area of Concern*: A minimum of one soil sample will be collected at this site from the worst case location and depth, based on geophysical logging results using driven probes. Additional samples will be considered based on the results of geophysical logging and field screening. *Investigation Method*: Sample the soil at the depth of the maximum Cs-137 concentration (corresponding to the bottom of the pond) using the GeoProbe to collect soil. Additional probes can be colocated to obtain sufficient sample volume if needed. Other field-screening techniques, such as hand-held radiation detectors, can be used in conjunction with the above guidance to determine actual sample depths. *Contaminants*: Nonradionuclides include antimony, cadmium, manganese, selenium, total uranium, silver, thallium, toluene, fluoride, cyanide, and nitrate [b]. Radionuclides include Cs-137, Eu-154, Sr-90, Tc-99, Np-237, Pu-239/240, Am-241, and U-238.	Use soil samples to determine other radiological and nonradiological COPC concentrations at selected area(s) of maximum Cs-137 concentrations.

Table A-16. Key Features of Model Group 5, Ponds, Sampling Design. (8 Pages)

Survey or Analytical Methodology	Key Features of Design	Sampling Design Rationale
216-S-17 Pond		
Geophysical Logging – Direct Push and Small-Diameter Spectral-Gamma Logging Tool	*Medium*: Soil *Specific Location/Area of Concern*: Nature and extent of contamination emanating radially from the pond inlet, to include a high-radiation area (15 – 450 mR/h) around the perimeter of the pond. *Investigation Method*: Fifteen direct pushes will be driven into pond soil beginning at the pond inlet (see Figure A-5). Probes will be placed along 5 transects emanating outward from the pond inlet and will be placed equidistant along the transects to the edge of the historical maximum-use area of the pond as identified by aerial photographs, markers, other historical information, and/or surface geophysics conducted to support the excavation permit. The probes will be driven approximately 4.6 m (15 ft) deep. The probes will be logged using small-diameter spectral-gamma instruments capable of detecting Cs-137 concentrations to 1 pCi/g. *Note*: Refer to the entry for UPR-200-W-124 in this table regarding a possible Phase 2 investigation associated with the 216-S-17 Pond. *Parameter*: Spectral gamma determined by Cs-137 activity above the logging action level for Cs-137 [c]. *Evolution(s)*: Locations with significant Cs-137 activity will be sampled.	The pond was 0.3 to 0.6 m (1 to 2 ft) deep during operations and was stabilized with 1.2 m (4 ft) of soil. Cs-137 is expected to be present based on discharge information and on historical data in the work plan (DOE/RL-99-66). Use Cs-137 for tracking contamination using geophysical logging techniques.
Soil Sampling	*Specific Location/Area of Concern*: Collect a minimum of one soil sample from the worst case location and depth, based on geophysical logging results using driven probes. Additional samples will be considered based on the results of geophysical logging and field screening. *Investigation Method*: Sample the soil at the depth of the maximum Cs-137 concentration (corresponding to the bottom of the pond) using the GeoProbe to collect soil. Additional probes can be colocated to obtain sufficient sample volume if needed. Other field-screening techniques, such as hand-held radiation detectors, can be used in conjunction with the above guidance to determine actual sample depths. *Contaminants*: Nonradionuclides include antimony, cadmium, manganese, selenium, total uranium, silver, thallium, toluene, fluoride, cyanide, and nitrate [b]. Radionuclides include Cs-137, Eu-154, Sr-90, Tc-99, Np-237, Pu-239/240, Am-241, and U-238.	Use soil sampling to determine other radiological and nonradiological COPC concentrations at selected area(s) of maximum Cs-137 concentrations.

Table A-16. Key Features of Model Group 5, Ponds, Sampling Design. (8 Pages)

Survey or Analytical Methodology	Key Features of Design	Sampling Design Rationale
UPR-200-W-124 (overflow area of the 216-S-17 Pond)		
Geophysical Logging – Direct Push and Small-Diameter Spectral-Gamma Logging Tool	*Medium*: Soil *Specific Location/Area of Concern*: Nature and extent of contamination emanating from the dike overflow at the southwest corner of the pond. The exact location of this unplanned release is indeterminate from records. *Investigation Method:* This is a phased investigation (i.e., Phase 2 of the 216-S-17 Pond characterization) that will be performed only if 216-S-17 Pond contamination is found beyond the expected site boundary. This location will be investigated if 216-S-17 Pond contamination levels exceed geophysical logging action levels for Cs-137. The investigation is to determine the location of this unplanned release using GeoProbes in 3 transects emanating outward from the southwest corner of the Pond (Figure A-5). The probes will be driven approximately 4.6 m (15 ft) deep. The probes will be logged using small-diameter spectral-gamma instruments capable of detecting Cs-137 concentrations to 1 pCi/g. No sampling is planned for this location. *Parameter*: Spectral gamma determined by Cs-137 activity above the logging action level for Cs-137 [c].	Use Cs-137 for tracking the contamination extent using geophysical logging techniques. Overflow area contaminants would be the same as 216-S-17 Pond contaminants, at the same or lower concentrations.

Table A-16. Key Features of Model Group 5, Ponds, Sampling Design. (8 Pages)

Survey or Analytical Methodology	Key Features of Design	Sampling Design Rationale
216-T-4B Pond		
Geophysical Logging – Direct Push and Small-Diameter Spectral-Gamma Logging Tool	*Medium*: Soil *Specific Location/Area of Concern*: Determine the general extent of contamination in the primary pond location and the ditch that fed the pond. *Investigation Method*: Two direct-push rods will be driven into ditch site soil and two will be driven into the ditch approximately 6 m (20 ft) deep, as shown in Figure A-6. The probes will be geophysically logged using small-diameter spectral-gamma instruments. *Parameter*: Spectral gamma determined by Cs-137 activity above the logging action level for Cs-137 [c].	The 216-T-4B Pond and the 216-T-4-2 Ditch that fed the pond are both located within the boundary of the 216-W-3AE Burial Ground RCRA treatment, storage, and disposal unit. The pond is considered to have been dry since 1977 (pre-RCRA), although the ditch received waste until 1995. The ditch and pond received steam condensate and evaporator cooling water from the 242-T Evaporator (a RCRA past-practice unit that ceased operations in 1982) and waste water from the 221-T (T Plant) Canyon Building air conditioning units and floor drains, not known to have been identified as a dangerous waste stream. Extensive contamination is not anticipated. The pond and ditch locations were not investigated and will be investigated under Model Group 5.
Sampling	If Cs-137 concentrations exceed the Cs-137 logging action level [c], collect a minimum of one soil sample from the worst case location. *Contaminants*: Nonradionuclides include antimony, cadmium, manganese, selenium, total uranium, silver, thallium, toluene, fluoride, cyanide, and nitrate [b]. Radionuclides include Cs-137, Eu-154, Sr-90, Tc-99, Np-237, Pu-239/240, Am-241, and U-238.	Sample information will provide initial baseline contaminant information and possibly could assist with closure of the RCRA treatment, storage, and disposal unit.

Table A-16. Key Features of Model Group 5, Ponds, Sampling Design. (8 Pages)

Survey or Analytical Methodology	Key Features of Design	Sampling Design Rationale
216-U-10 Pond		
Geophysical Logging of Direct Push and Borehole using Small-Diameter Spectral-Gamma Logging Tool	*Medium*: Soil *Specific Location/Area of Concern*: Determine general extent of contamination in the primary pond location and ditch that fed the pond. *Investigation Method*: This investigation will require installation of direct-push probes, test pits, and a borehole as identified in Figure A-7. Eight direct-pushes will be installed to a depth of 6 m (20 ft) as shown in Figure A-7 and will be geophysically logged for gross gamma from Cs-137. The probes will be logged using small-diameter spectral-gamma instruments. One new borehole approximately 42.7 m (140 ft) deep will be installed in the immediate vicinity of existing Borehole 299-W23-231 (Figure A-8). The borehole will be geophysically logged. *Parameter*: Spectral gamma determined by Cs-137 activity above the logging action level for Cs-137 [c].	Use Cs-137 for tracking the extent of contamination using geophysical logging techniques.
Sampling	*Test-pit samples*: Test pits at three locations will be installed to locate and identify the depth and thickness of the organic mat. The mat could be located visually or by use of hand-held radiological survey instruments. Once the organic mat at each test pit is located, take two samples – one of the mat material and one of soil directly below the mat – at each of the 3 locations for a total of six test-pit samples. *Borehole sample(s)*: Collect one sample at the pond bottom equating to pond sediment layer (organic mat). Collect one sample at 4.6 m (15 ft) bgs and one sample at depth (approximately 42.7 m or 140 ft bgs). *Direct-push probe sample(s)*: Collect a minimum of one soil sample from the worst case location of the Cs-137 concentrations that exceed the Cs-137 logging action level [c]. *Contaminants*: Nonradionuclides include antimony, cadmium, manganese, cyanide, selenium, total uranium, silver, thallium, toluene, fluoride and nitrate [b]. Radionuclides include: Cs-137, Eu-154, Sr-90, Tc-99, Np-237, Pu-239/240, Am-241, and U-238.	Test-pit samples will represent the organic mat at the pond bottom and the location of most contamination because of sorption of contaminants onto organic materials. The borehole will be used to clear up an outstanding data quality issue and to evaluate uranium with depth. Push-probe samples taken at the Cs-137 hot spots are intended to represent worst case conditions at the pond and facilitate evaluation of a partial-removal alternative.

Table A-16. Key Features of Model Group 5, Ponds, Sampling Design. (8 Pages)

Survey or Analytical Methodology	Key Features of Design	Sampling Design Rationale
216-U-11 Ditch		
Geophysical Logging – Direct Pushand Small-Diameter Spectral-Gamma Logging Tool	*Medium*: Soil *Specific Location/Area of Concern*: Determine general extent of contamination in the primary ditch sections and in the shallow overflow area between the ditch sections. *Investigation Method*: Fourteen direct pushes will be driven into ditch site soil as shown on Figure A-9. Seven will be driven into ditch sections, and seven will be driven into the shallow overflow area soils on the interior of the ditch, approximately 3 m (10 ft) deep, and placed along two transects as shown in Figure A-9. The probes will be logged using small-diameter spectral-gamma instruments. *Parameter*: Spectral gamma determined by Cs-137 activity exceeding the logging action level for Cs-137 [c].	Use Cs-137 to identify the extent of contamination along ditch length and in the shallow overflow area. This ditch was expected to be approximately 1.8 m (6 ft) deep during operations. Because the horseshoe-shaped ditch was fed by overflow from the 216-U-10 Pond, ditch contaminants are expected to be the same as 216-U-10 Pond contaminants. The ditch is known to have overflowed into the interior portion of the south end of the horseshoe shape.

[a] Because of the large body of characterization data available for the representative 216-B-3 Pond waste site, B Pond-specific COPCs for this action are represented by the more focused list of COPCs from Table 5-1 of the 200-CW-1 Operable Unit feasibility study (DOE/RL-2002-69).

[b] This site is an analogous site to the well characterized representative waste site 216-U-10 Pond. As a conservative measure because of the absence of data for this analogous site, the 200-CW-5 remedial investigation report (DOE/RL-2003-11), Table 6-1, list of 216-U-10 Pond COPCs will be applied and will be expanded to include nitrate (per data quality objectives discussion), U-238 (per WIDS), fluoride and cyanide (identified through STOMP modeling [PNNL-12028]), and Pu-239/240 and Am-241 (identified by earlier 216-U-11 Ditch sampling).

[c] The logging action level for Cs-137 is 24 pCi/g (main text Section 3.1.1).

GeoProbe is a registered trademark of GeoProbe Systems, Salina, Kansas.

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PNNL-12028, *STOMP Subsurface Transport Over Multiple Phases, Version 2.0, Application Guide.*

Resource Conservation and Recovery Act of 1976.

Waste Information Data System database.

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980.*
COPC = contaminant of potential concern.
RCRA = *Resource Conservation and Recovery Act of 1976.*
STOMP = subsurface transport over multiple phases.
WIDS = *Waste Information Data System.*

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